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MATHEMATICAL ACHIEVEMENT

OF ELEVEN YEAR OLD CHILDREN IN WALES

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ABSTRACT

This study investigates the mathematical achievement of eleven year-old pupils in Wales and the effects the introduction of the National Curriculum may have had on mathematical performance at this age.

The study aims to establish whether mathematical competency is in decline, which specific areas of mathematics pose the greatest difficulty for pupils, and whether differences in achievement exist between genders at this age. The study also aims to clarify the effects the introduction of the National Curriculum may have had upon mathematical achievement and teaching and learning mathematics generally.

To achieve these aims the study contains two elements, a local study and a national study, in addition to an extensive literature review.

The local study is based upon analysis of children's performance and achievement in mathematics on a test instrument within a junior school in South Wales. Data is drawn from a sample of 766 pupils over the twelve year period 1983 to 1994 and is analysed using a variety of statistical techniques. It is concluded that:

- There is a good standard of achievement throughout the twelve year period, with 71.1% of boys and 69.9% of girls achieving half marks or more in the test. The overall trend is upward, refuting the notion that mathematical competency is in decline.

- There is a noticeable improvement in achievement in the years 1992 to 1994, possibly as a result of the introduction of the National Curriculum in 1988.

- Pupils are most successful in the area of computational skills, whilst the application of concepts and skills of mathematics proves the most difficult area.

- The three years 1987, 1992 and 1994 show significant differences in achievement between genders, with boys outperforming the girls. In the remaining nine year achievement between genders is comparable.

The national survey focuses specifically upon the perceptions of head teachers, deputy head teachers and teachers in relation to the introduction of the National Curriculum and its effect upon the teaching and learning of mathematics at Key Stage 2. A 5% stratified sample of primary schools in Wales were surveyed using a dedicated questionnaire designed by the researcher, a sample of 84 schools from 21 of the 22 Educational Authorities in Wales, where 420 questionnaires were distributed. Detailed analysis of the questionnaire responses reveal that the National Curriculum has:

- provided benefits in terms of the knowledge gained by pupils;
- not enhanced schools overall ethos in relation to developing the affective domain of their pupils;
- created a significant improvement in staff attitudes with respect to staff morale within the teaching profession;
- created a positive climate in which staff may call upon colleagues' expertise and experience in the form of support mechanisms for delivering the curriculum;
- provided clarity in terms of the objectives and outcomes schools are able to set for their mathematics teaching;
- provided a viable curriculum in relation to the content of the mathematics syllabus;
- provided a catalyst for the development and refinement of curriculum methodology;
- not provided benefits in terms of improved relationships between the school and the wider external community;
- initiated development and improvements in relation to mathematical textbooks available for delivering the subject;
- provided clarity in relation to the adoption of specific subject teaching methodologies within schools;
- improved the chances of raising standards in primary education.

CERTIFICATE OF RESEARCH

This is to certify that, except where specific reference is made, the work described in this thesis is the result of the candidate. Neither this thesis, nor any part of it, has been presented, or is currently submitted, in candidature for any degree at any other University.

Signed Nigel J. Coombes
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Date 31st October 2000

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PREFACE

There are two aspects of study contained within this dissertation. The first (the local study) relates to a local or micro study based upon pupils' performance in mathematics throughout a twelve year period within a junior school in Wales. The second aspect (the national study) focuses upon a national survey which was undertaken using a representative sample of schools throughout Wales.

The following aims of this study are very much supported and directed by the literature review, i.e., Chapter 1 'Curriculum Development within the United Kingdom', discusses how and why the curriculum has been established and developed within the U.K. up to the present situation of a centrally controlled National Curriculum.

Chapter 2 'Mathematics within the School Curriculum', reviews and evaluates the status of mathematics within the school curriculum.

Chapter 3 'Achievement within Education', identifies the key elements and concepts which impinge upon achievement within education at an individual and institutional level.

The aim relating to the local study aspect is to compare the mathematical performance of successive cohorts of eleven year old children at the end of Key Stage 2 of the National Curriculum framework, considering:

- whether evidence exists to substantiate the claim that mathematical competency is in decline;
- which specific areas of the mathematics curriculum pose the greatest problems for children at this age;
- whether there are any significant differences in mathematical performance between boys and girls at this age;
- what effects the introduction of the National Curriculum may have on the mathematical achievement at eleven years of age.

The aim of the national study is to investigate the impact of the National Curriculum framework upon primary schools in Wales, with particular focus upon mathematics within Key Stage 2. In particular, the research seeks to answer the research questions set out below:

- Has the National Curriculum provided benefits in terms of the knowledge gained by pupils?
- Has the National Curriculum enhanced schools overall ethos in relation to developing the affective domain of the pupils?

- In what way has the National Curriculum affected staff attitudes with respect to staff morale within the teaching profession?

- Has the National Curriculum created a climate in which staff may call upon colleagues expertise and experience in the form of support mechanisms for delivering the curriculum?

- Has the National Curriculum provided clarity in terms of the objectives and outcomes schools are able to set for their mathematics teaching?

- In relation to the content of the mathematics syllabus, does the National Curriculum provide a viable curriculum?

- Has the National Curriculum provided a catalyst for the development and refinement of curriculum methodology?

- Has the National Curriculum provided benefits in terms of improved relationships between the school and the wider external community?

- Has the National Curriculum initiated development and improvements in relation to mathematical textbooks available for delivering the subject?

- Has the National Curriculum provided clarity in relation to the adoption of specific subject teaching methodologies within schools?

- Has the National Curriculum improved the chances of raising standards in primary education?

The methods and procedures followed to achieve these aims are outlined and discussed fully in Chapter 4 'The Research Methodology'

CHAPTER 1

CURRICULUM DEVELOPMENT WITHIN THE UNITED KINGDOM

1.1 CURRICULUM DEVELOPMENT

1.1.1 Introduction

With the introduction of the National Curriculum within the United Kingdom (1988), it is clearly essential to fully understand the relationship between the curriculum and the learning process. This chapter discusses the extant research on the 'curriculum', offering a range of definitions and perspectives, all of which appear to have some influence on curriculum development up to and including its present position.

Having offered definitions of the many aspects of the curriculum, consideration is then given to the process of curriculum development through a range of innovations that have been undertaken within the education system over the past decades. To establish the connection between the curriculum and the process of its implementation, a range of curriculum models are discussed. These illustrate the diverse nature of the education process from school to school, within the United Kingdom.

The chapter concludes with an overview of the National Curriculum, discussing its introduction and its implications, before finally focussing upon its content and the statutory assessment framework within Wales.

1.1.2 The Curriculum Concept

The key role of the curriculum in creating educational experiences was identified by Taylor and Richard's (1979). They noted:

> *The content of education, the curriculum, is at the heart of the educational enterprise. It is a means through which education is transacted. Without a curriculum education has no vehicle, nothing through which to transmit its messages, to convey its meanings, to transmit its values.*

Beauchamp (1961) defined curriculum as 'a design of a social group for the educational experiences of their children in school'. Maccia (1965) presents the curriculum in terms of the instructional content presented.

The school is also located in an educational system where there are considerable benefits to be reaped through collaboration and co-operation with other schools and through support from local authorities (Stoll & Fink, 1994), Universities (Fullan, Bennett & Rothelser-Bennett, 1990), or external consultants (Louis & Miles, 1990).

As will be shown in this chapter, the 'curriculum' is one of the dynamic processes within any education system. This study will look at factors which impinge upon and interact with considerable effect upon the outcomes of the curriculum

Johnson (1967) defined the curriculum as 'a structured series of intended outcomes'. Whilst Inlow (1966), stated that 'curriculum is the planned composite effort of any school to guide pupil learning towards predetermined learning outcomes'.

Neagley and Evans (1967) considered curriculum as 'all planned experiences provided by the school to assist the pupils in attaining the designated learning outcomes to the best of their abilities'. However, Hirst (1968), considered the term curriculum to be excessively broad and related it to a programme of activities designed to enable pupils to attain as far as possible, certain educational objectives. This idea was modified by Barrow (1984), defining the curriculum as:

> *a programme of activities (by teachers and pupils) designed so that pupils will attain so far as possible certain educational and other schooling ends or objectives.*

Taylor (1968), identified the curriculum as consisting of content, methods and purpose, with these three dimensions interacting dynamically to form the curriculum. It is interaction via this vehicle which enables pupils' curricula experiences and involves teachers in teaching. The outcomes of such interaction is intended to be an improvement in achievement, skills, values and beliefs. Charlton (1968) added the further dimension of evaluation, stating curriculum was not only content but also methods, objectives and evaluation.

Kerr (1968), pointed out the variety of ideas given to the concept of curriculum has been a major source of confusion within curriculum study and indeed, when translating curriculum development into practice. Many use the term loosely, being synonymous with 'syllabus', 'courses of study', 'subjects' and even 'timetable'. Kerr defined curriculum as:

> *all the learning which is planned and guided by the school, whether it is carried on in groups, individually, inside or outside the school.*

Stenhouse (1975) offered two different views of the curriculum. Firstly, it may be seen as an intention, plan or prescription, an idea of what one would like to happen in schools. Alternatively, it may be seen as the current, existing state of affairs in schools, that is, that which does in fact actually happen. This is a concern between intention and reality, within a given situation.

Taylor and Richards (1979) stated 'curriculum and content of education mean one and the same thing', that is, the content of education is the oldest meaning of the word curriculum. Lawton (1983) saw curriculum as 'a selection from a culture'. Therefore, if a curriculum is a plan of instruction, defining curriculum from a selection from a culture widens the range of curriculum studies to include justification as well as evaluation.

Hallinan (1987) took an organisational perspective, arguing that curriculum is the primary determinant of what children acquire in school, whilst curriculum transmission is a dynamic process. Seddon (1983) sees the hidden curriculum as the learning of norms, values, beliefs attitudes and assumptions often expressed as rules, rituals and regulations which are taken for granted and rarely questioned.

Kelly (1982) sees the hidden curriculum as those things which children learn because of the way in which work in school is planned and organised but are not in themselves overtly included in the planning stage of development. Dean (1983) notes that some

of what children learn at school are hidden, not only from the children, but from the teachers, accordingly this is by definition hidden, a school can not control it.
A clear distinction between 'official' curriculum and the 'actual' curriculum, as well as 'formal' and 'informal' curriculum, was made by Kelly (1982). He stated:

> *by official curriculum is meant what is laid down in syllabuses, prospectuses and so on, the actual curriculum being what is covered in the practice of the school.*

Within the formal curriculum are included those activities for which the timetable of the school allocates teaching time. Informal activities, usually on a voluntary basis, at lunch times, after school hours, at weekends etc. are included in the informal curriculum.

Dearden (1981) pointed out the concept of a balanced curriculum. He noted just as a balanced diet is assumed to be good, so is a balanced curriculum. He discusses this point, noting that whilst the idea of a balanced diet rests on well-established scientific data, there is no such agreement about what constitutes a balanced curriculum, that is, the idea of a balanced curriculum is meaningless unless there is some kind of prior commitment to the contents of the curriculum.

Kean (1969) identifies the current emphasis for 'balance' in the curriculum, as a direct result of the failure to achieve this kind of total planning, resulting in the unbalanced curriculum, experienced by many pupils. The notion of balance must include several elements. First, the balanced curriculum must be viewed and planned as a totality and not in a piecemeal approach. Further, a real balance of educational experiences is required with a balance between the needs of the individual for personal and vocational preparation.

1.1.3 Curriculum Innovation

Fullan (1993), describes change as:

> *a journey, not a blueprint. It is non-linear, loaded with uncertainty and sometimes perverse.*

Within educational literature, the terms 'change', curriculum development', and 'innovation' are used in different contexts. Hoyle (1972) defined 'change' as a generic term embracing a family of concepts (e.g. development, growth, innovation etc.).

Fullan (1991), quoted by Still & Fink (1996), argue that although not all change is improvement, all improvement involves change. It is therefore crucial to understand the complexity of change and the processes which are involved.

Curriculum development is a difficult concept to grasp, even more difficult is a means to pin it down definitively. Taylor and Richards (1979), states:

> *The term 'curriculum development' is considered as comprising those deliberately planned activities through which courses of study or patterns of educational activity are designed and presented as proposals for those in educational institutions.*

This implies a degree of systematic thinking and planning during which individual decisions about content, methods and learning are occurring in relation to an overall framework. At one stage, curriculum development may result in radically new proposals, resulting in far reaching implications for teachers and pupils alike. Alternatively, curriculum development may just result in the slight modification or adjustment to a teaching programme or syllabus.

Nicholls and Nicholls (1974) stated the planning of learning opportunities intended to bring about certain changes in pupils and the assessment of the extent to which these changes occur is what is meant by curriculum development.

The object of curriculum development according to Stenhouse (1975) was the improvement of schools through the improvement of teaching and learning. The notion being that ideas should encounter the discipline of practice and that practice should be principled by ideas. The curriculum development movement is an attack on the separation of theory and practice.

Lawton (1983) stated curriculum development takes place for a variety of motives. Accordingly, it happens when individuals or groups, especially teachers and others concerned with the planning of the curriculum, are dissatisfied with what is being taught or with the methods used in the classroom.

A number of factors within the school are important in curriculum development; local industrial and employment conditions; the social origins and interests of the pupils and parents; the expectations of the school. The most significant of these factors, according to Kelly (1982), were the attitudes of the teachers within the school. Clearly, the effect of any attempted change within a school is largely determined by the extent to which individual teachers become committed to it, staff must also understand the concept of the change as well as believe in it. Lortie (1975), indicates that these aspects are liable to make teachers, who are generally conservative by nature, antagonistic to change; there is little incentive in the form of career advancement, for them to innovate, also, change requires considerable investment in time and energy on their part.

Dean (1985) proposes that in a world which is constantly changing, the curriculum should also constantly change. Within subjects where the content is not necessarily changing, the emphasis will certainly change. Shipman (1976) notes that innovations do not exist in any unchanging, objective sense, they are constantly being defined, changed and redefined as a result of experience and the differing perceptions of the people who handle them.

Kelly (1980), points out that when there is widespread concern that courses and teaching methods are out of date, coupled with pressures from society to reform, then it is time for innovation. The word innovation as used during the 1960's, related to reform, changing things for the better. Curriculum development projects were seen as development in terms of offering new content, methods and materials. This model was of the Centre-Periphery type, where courses were developed by relatively small groups and then made available to schools for implementation. These courses were carefully planned and usually involved pilot studies, field testing and evaluation. Examples of such innovations noted by Pantelides (1973), were the School Mathematics Study Group (SMSG), the Science Testing Project (MINNEMAST), along with the Nuffield Mathematics Project initiated in London in 1964.

Gross (1971) indicated five barriers to the implementation of any innovation:

- the teachers lack of understanding about the innovation;
- the teachers lack of skills or subject knowledge required for the new model;
- the unavailability of instructional materials;
- organisational incompatibility with the innovation;
- loss of staff motivation.

Kelly (1990) identified a major problem of curriculum development as being the narrowing of the gap between the intentions of the planners and the realities of the attempts to implement the plans.

Rowntree (1982) suggests that the less disruptive an innovation is to current practices and attitudes, the greater chance it has of adoption. Therefore, new teaching aids are more readily adopted than new learning materials, which are more acceptable than new curriculum purposes. All of these are more acceptable than new organisational structures, with new roles and personal relationships which are the most difficult to implement.

According to Kelly (1982), the key to change was that dissemination replaced diffusion. This was indicated by MacDonald and Walker (1976), who stated:

> *Once the curriculum movement got into 'third gear' the term 'diffusion', suggesting a natural social process of proliferation, gave way to the term 'dissemination', indicating planned pathways to the transmission of new educational ideas and practices from their point of production to all locations of potential implementation.*

The process of dissemination may be seen as systematically planned attempts at providing information, thus enabling individuals to understand what new curricula involve. The process of 'diffusion' is described by Taylor and Richards (1979) as the way in which information about the curriculum spreads through the educational system. Therefore, according to Barrow (1984), diffusion refers to the manner in which curriculum comes to be adopted, while dissemination refers to the means adopted to try and ensure that it is adopted.

Kelly (1982) points out that problems can arise from two major sources. First, the effectiveness of this process is determined by the many constraints which limit all forms of curriculum development - finance, staff attitude, mobility of pupils, parental pressures and examinations. The second set of problems for programmes of dissemination arise from the models of dissemination.

Such models of dissemination were described by Schon (1971), that is, the Centre-Periphery Model, the Proliferation Model and the Shifting Centers Model. The Centre-Periphery Model assumes the processes of dissemination must be centrally controlled and managed. The proliferation of Centres model creates secondary centres to extend and support the primary centres. The Shifting Centres model is used to explain the spread of ideas.

Kelly (1990) noted the Centre-Periphery model proved largely ineffective in bringing about genuine change, as a result of:

- a wide gap of the notion of the curriculum held by central planners and that of teachers implementing the curriculum in the classroom;
- attempts at innovation are unsuccessful if teachers are seen as a passive recipient of change;
- teachers need to be committed to any planned change. The motivation and attitude of teachers is crucial to the success of the innovation.

Fullan (1991) noted, often where improvement initiatives had been attempted, they were of the ‘quick fix’ solutions which failed to last. The attitudes of staff are of great importance regarding the success of an innovation. The innovation cannot succeed unless the majority of staff are behind the ideas. As stated by the Schools Council (1971, p.15), 'it is important to have the majority positively inclined to curricula change'.

Clearly, all schools are different. The changes, or lack of them, at any stage are diverse and are themselves susceptible to variation and will impact differently on the enhancement of pupil progress and achievement (Hopkin, Harris & Jackson, 1997). Many head-teachers who initiate change are new to both the post and the school. Bullock, James and Jamieson (1995) notes they are often unaware of the finer details of the schools’ circumstances, micro-politics and cultural history.

1.1.4 Curriculum Planning

In response to demands for schools to become more 'efficient' and utilitarian Bobbitt (1918) defined a model which was to become known as the efficiency model. Bobbitt's interest was not simply the making of a curriculum, but of defining how to make a curriculum (Howson *et al.*, 1981). Therefore this was the first model of the curriculum that led to an organised study of the subject.

Bobbitt's model of curriculum organisation, known generally as the objectives model, is now one of a whole range of models that are usually classified within one of three areas. These being, the objectives model, the process model and the situational analysis or cultural analysis model.

1.2 CURRICULUM MODELS

1.2.1 The Objectives Model

The objective model as described by Gordon (1981), evolved as a result of two events. First, the rapid expansion within the USA from 1990 on, of the secondary education system. This expansion resulted in a number of attempts to apply industrial efficiency to school systems. Second, the rapid expansion within Britain of the elementary system from 1834 to 1860. This resulted in the 'Revised Code' of 1862, which was extremely objectives based, giving rise to the primitive accountability process known as 'payment by results'.

Resulting from attempts to apply scientific management principles to education Bobbitt's approach became known as the 'scientific approach' to curriculum development. In an attempt at using industrial management processes, which focused upon eliminating wastage, maximising output and increasing profits, the efficiency model viewed pupils as an 'input', which following instruction should perform specific skills as an 'output'. This resulted in the evolution of the term 'output model' which is often applied to the objectives model.

The work of Bobbitt developed from the work of F.W. Taylor, often quoted as being the father figure of the scientific management movement. The processes developed within education were called 'job analysis'. This resulted in an itemised list of specific verbal and motor skills that are required in everyday life, these were then taught in schools. This 'job analysis' can be seen as a first attempt at developing educational objectives, also it was the first move towards performance-based education. The basic principles of this model are summarised by Flouris (1983), who states:

a. *Curriculum purposes should be described objectively. When describing curriculum aims, general statements should be avoided.*

b. *Proposed learning outcomes should be described as units of behaviour, with a definition of the standard to which that unit is aspiring.*

> c. *The standard of a unit of behaviour should account for the method by which this behaviour should be attained.*

Bigge (1982), when discussing the scientific approach, states 'an entire generation of curriculum makers in the 1920's and 1930's, adopt this approach'. Clarifying this approach, Tyler (1949), argued the following four fundamental questions should be answered when developing any curriculum:

1. What educational purposes should the school seek to obtain?
2. What likely educational experiences can be provided to attain these purposes?
3. How can these experiences be organised?
4. How can we establish whether these purposes are being attained?

Tyler (1949) emphasises that educational objectives are indispensable in planning a curriculum, stating:

> *they become the criteria by which materials are selected, content is outlined, instructional procedures are developed and tests and examinations are prepared (ibid).*

Therefore, when planning any curriculum programme, considerable attention must be paid and a balanced selection made from specific sources of educational objectives. These being, the learners, contemporary subject specialists, philosophy and the psychology of learning. The Tylerian model is represented by:

1 Aims & Objectives → 2 Content → 3 Organisation → 4 Evaluation

The linear form of this model was criticised by many educationalists. Many felt this rationale left evaluation to the end of the process, whereby they argued, evaluation should occur at every stage. This led to the idea of a cyclical curriculum model.

The first to use a cyclical model of curriculum process was Wheeler (1967). This consisted of the following five elements:

- Aims, goals and objectives
- Selection of learning experiences
- Selection of content
- Organisation and integration of learning experience and control
- Evaluation

This model of the curriculum process (see Figure 1.1), allows for the interrelationships of the separate processes between them.

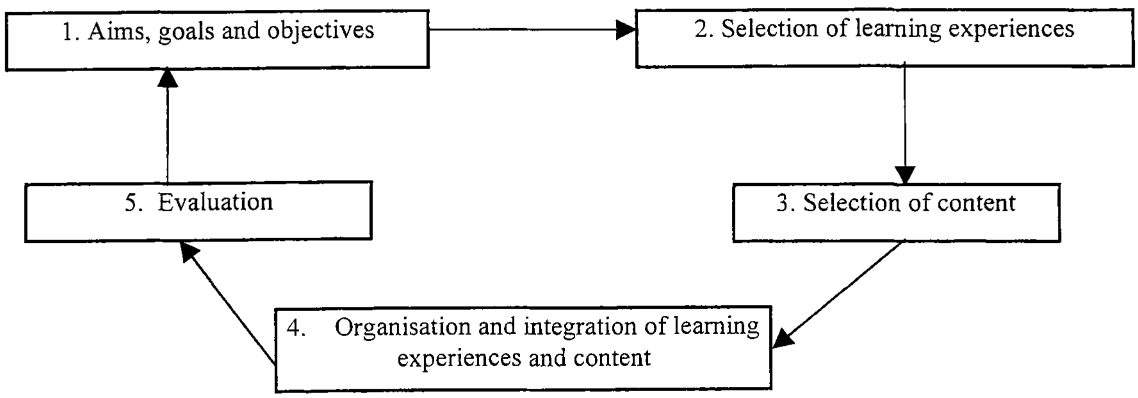

Figure 1.1: Cyclical Curriculum Process
(Adapted from Wheeler, D.K. (1967), 'Curriculum process'. p.31, Figure 1, University of London Press Ltd. London)

Tyler's model, which outlines the scientific and technological approach to the curriculum, was adopted by many theorists who sought to extend and develop the basic model. Among them are such eminent educationalists as Hilda Taba and John Goodlad. Taba (1962), worked upon a more specific model than Tyler, consisting of the following six stages:

- Needs diagnosis
- Formation of objectives

- Content selection
- Choice of learning experiences
- Organisation of learning experiences
- Decision of what to evaluate and the means to undertake evaluation

Additionally, Taba was influenced by the work of John Dewey. This aspect is reflected in her concern for the individual's needs and the concept that the pupil's needs should ultimately become the main elements of the curriculum's objectives. However as outlined by Howson *et al.*, (1981), Taba put considerable emphasis on the point that decision making on curriculum issues should be based upon comprehensive theories of society and cognition along with comprehensive anthropology. Resulting from this, Taba's work progressed from the theoretical basis to the practical issues of designing curricula modules.

Alternatively, Goodlad (1966), placed more emphasis on values within his curriculum model, consisting of the three elements:

- Values
- Educational aims
- Learning opportunities

Within the UK, the objectives model has had very limited application. The Schools Council curriculum project, for example, Science 5 - 13, initially used the model, although the objectives approach was not sustained throughout the whole project (Gordon, 1981). However, as Gordon (1981) indicated, one writer (J.E. Merritt) put forward a model based upon the four stages of:

- Setting goals
- Designing plans
- Implementing the plans
- Developing from achievements

A more complex version of Merritt's model was used in the Open University Course E283, Unit 10, (*ibid*). This model was built around the eight elements: Aims, Objectives, Strategies, Tactics, Methods, Techniques, Evaluation and Consolidation.

Rowntree (1982), developed a model based upon educational technology, using a four-phase cyclical approach:

- Identify objectives in terms of purpose
- Define the appropriate learning experiences
- Evaluate the effectiveness of the learning experiences
- Develop and improve the learning experiences offered

Educational Technology applies the systems view to education, as it regards education as being a system which operates within the framework of a supra-system, that is, society. A system is complete, structured and ordered whole of related and interactive processes and components. It is also hierarchical and it comprises sub-systems within itself. It may be natural or contrived, open or closed. An open system is one which interacts within the environment of its operation, also it may re-organise itself as a result of evaluation within that environment. A closed system is independent of environmental influences.

The scientific approach has become a major approach to curriculum development work. However, there has been a number of objections to the behaviourist approach to curriculum development. Lawton (1983, p.18), points out that Tyler returned to this field at a later stage and criticised some versions of his model, in particular, he criticised:

> *those who failed to distinguish between the learning of highly specific skills for limited job performance and the more generalised understanding, problem solving skills and other kinds of behavioural patterns that thoughtful teachers and educators seek to help students develop.*

1.2.2 The Process or Input Model

Stenhouse (1970), argued that within education it is more important to outline content and the established principles of procedure rather than specifying objectives. He argues that for many aspects of a school curriculum no one knows the "correct" answer. Therefore it is foolish to specify objectives, and it is more important to engender a positive attitude of mind along with a precise set of procedures that can be held by the teacher. Consequently a prime principle of the process model is teacher encouragement for pupils to explore worthwhile educational areas and processes, rather than attain certain pre-specified conclusions or information.

Objections raised about this model focus upon whether Stenhouse's model could be considered as a whole curriculum model (Kelly, 1977). Additionally, Kelly (1977), questions whether this model is acceptable in terms of developing teachers' professional skills, but is unacceptable in terms of needs based upon school, regional and national requirements.

1.2.3 The Situational Analysis or Cultural Analysis Model

Lawton (1981) identifies this model as being based upon the ideas of common culture and common curriculum, first suggested in the work of Smith *et al.* (1971) in the USA. In the UK similar ideas were expressed by Williams (1961). Skillbeck's (1976) example of this model is found in the Open University Course E203, Unit 28, with a much more enhanced version described in Culture and the Classroom, by Reynolds and Skillbeck (1976).

This curriculum model is essentially eclectic and includes elements of both the objectives approach and the process model approach. Skillbeck refers to his model as 'situational analysis', whilst acknowledging the curriculum is essentially value laden and political in character. However, an individual school must come to terms with the wider social context of the school and plan its curriculum accordingly.

Lawton (1983, 1989) discusses another derivation of this model, known as the 'cultural approach'. The advantages of this approach is whereas the objectives model is overly dependent on an industrial psychological view and the process model overly influenced by philosophy, cultural analysis is essentially multidisciplinary (Gordon, 1981). The principles of this model requires a look at society as it is currently, in addition to examining the curriculum of the past, and thereby attempt to plot trends of development.

This model encapsulates the wider educational ideology, known as reconstructionism. This is considered to be one of three key ideologies which as discussed by Lawton (1983), enables different forms of curriculum theory to develop, as identified by Skillbeck (1976): Classical Humanism, Progressivism and Reconstructionism.

The main theme of reconstructionism is that education is primarily concerned with the transmission of culture to the next generation. Therefore education must not only benefit the individual in isolation but also society as a whole. Therefore a reconstructionist curriculum would be an open curriculum based upon selections from the culture of a society. Lawton (1983) defines the term 'culture', to represent the whole way of life within a society, that is, tools and technology, science and arts, values and morals along with language and literature.

Cultural analysis is a process through which a selection from culture can be made. Lawton (1983), implies cultural analysis, when used for curriculum planning, should answer the following four questions:

- What sort of society exists?
- How is it developing?
- How does its members want it to develop?
- What values and principles will be chosen and by which means will development be realised?

Cultural analysis uses three forms of classification. First, the major parameters (cultural invariants) must be chosen. Such parameters are basic characteristics common to all human beings, and may be grouped within systems such as:

- Social structures within a society;
- Economic;
- Communication;
- Rationality;
- Technology;
- Morality;
- Belief;
- Aesthetic.

During a second stage, there is a move from cultural invariants to cultural variants, that is, an outline using the major parameters of a method of analysis used to define any given society. A third stage involves an appropriate choice from the culture to allow the above eight characteristics a reasonable place within the curriculum. Through such a process a 'balanced' curriculum is achieved.

Additionally, a fourth stage may be identified as the contribution of psychology within curriculum development, preceding any aspect of organisation. This is displayed in Figure 1.2, whereby Lawton's (1983) model of Cultural Analysis is shown:

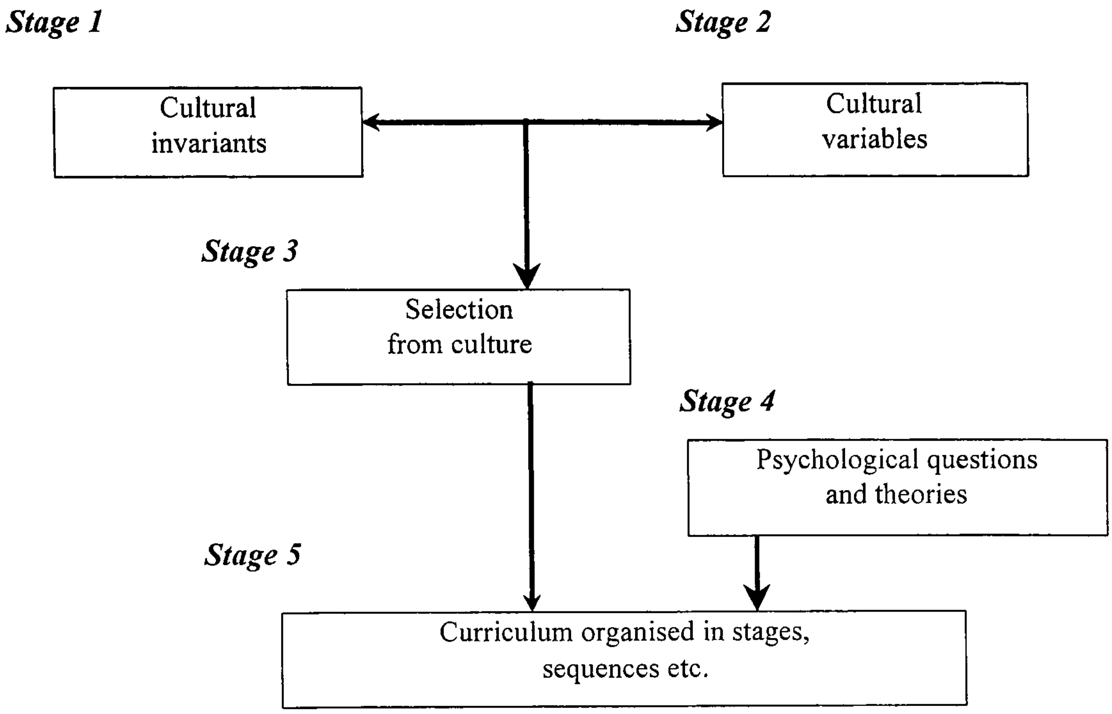

Figure 1.2: Lawton's Model of Cultural Analysis

(Adapted from Lawton, D. (1983), 'Curriculum Studies and Educational Planning'. p.30, Fig.2, Hodder & Stoughton. London)

1.2.4 Conclusions

Discussion of the three main categories of curriculum development models has shown how different concerns, over considerable periods of time, have enabled different models of curriculum planning to evolve. The objectives model evolving from concern for scientific planning, with its principles being based in the pre-specification of intended outcomes seen in the form of behavioural objectives. The process model, developing from the concern of processes rather than with intended outcome, thus establishing the teacher as a classroom based researcher. The cultural analysis model emerged from a concern for acceptable principles and procedures when developing a curriculum based upon the balanced selection of cultural issues.

Clearly, the issues are very complex requiring further review of the key elements of curriculum development, defined within the text to date as curriculum objectives, that is, the actual content, methods and evaluation processes of the learning activity.

1.3 A CURRICULUM FOR LEARNING

1.3.1 Curriculum Objectives

Clearly, a distinction is necessary between the terms aims and objectives. Aims are general statements of desired goals, thus they do not provide specific guidelines for curriculum planners (Taba, 1962). Objectives are derived from the aims. Krahtwohl (1964) set out the range of levels required when developing a curriculum. Initially, the statements of goals which affect the whole process are established. Following this, behavioural objectives, which affect the planning of modules or courses are developed from the established goals. Finally, specific detailed behavioural objectives will be established which relate directly to specific lesson contents.

Kelly (1977) defines objectives as 'intended learning outcomes'. As a result of using expected behaviour they are generically known as 'behavioural objectives', which Popham (1969) argues unambiguously describes an observable behaviour, or outcome, of a learner.

Bloom (1956) was the first to offer taxonomies of educational objectives, whereby, the three areas of cognitive, psychomotor and affective domains were established. Cognitive objectives considers the learner in terms of thinking processes; psychomotor objectives considers forms of muscular activity; whilst affective objectives considers issues relating to the learners attitudes and feelings.

The cognitive and affective objectives were further classified in terms of their complexity level. Bloom (1956) outlined the following hierarchy of objectives:

1 **Knowledge** of
- 1.a Specifics
- 1.b Terminology
- 1.c Specific facts
- 1.d Methods of dealing with specifics
- 1.e Conventions
- 1.f Trends and sequences
- 1.g Categories and classifications
- 1.h Criteria

1.i Methodology
1.j Universals and abstractions in a field
1.k Principles and generalisations
1.l Theories and structures

2 **Comprehension**
2.a Translation
2.b Interpolation
2.c Extrapolation

3 **Application**

4 **Analysis** of
4.a Elements
4.b Relationships
4.c Organisational principles

5 **Synthesis**
5.a Of unique communication
5.b Of a plan
5.c Of deriving abstract relationships

6 **Evaluation**
6.a Using internal evidence
6.b Using external criteria

Krahtwohl, Bloom and Masia (1964) went on to develop the following five levels within the affective domain:

1 **Receiving**
1.a Awareness
1.b Willingness to receive
1.c Controlled, selected attention

2 **Responding**
2.a Acquiescence in response
2.b Willingness to respond
2.c Satisfaction in response

3 **Valuing**
3.a Acceptance
3.b Preference
3.c Commitment

4 **Organisation**
- 4.a Conceptualisation of a value
- 4.b Organisation of a value system

5 **Characterisation by a value**
- 5.a Generalised
- 5.b Characterisation

Bloom does not offer any taxonomy based upon psychomotor objectives. Simpson (1965), however, described the following five levels:

a. Perception

b. Set

c. Guided response

d. Mechanism

e. Complex overt response

Other taxonomies based upon behavioural objectives have been developed. Mager (1962) improved a method for stating objectives in behavioural terms. Romiszowski (1981) developed the objectives model by including interactive or interpersonal skills, whereby consideration is given to the means in which people interact with one another.

Although having wide acceptance, Bloom's taxonomy was criticised by many. It was considered, by Kelly (1977) to be over specific in content, and lacking a clear idea of education because of its lack of evaluation criteria. The first criticism focuses upon the argument that no child's activity belongs singularly to any one of the three domains. Pring (1971) argues that the segregation of knowledge and skills from the promotion of feelings for standards and beauty may constitute a violence against education itself, moreover, he argues the dangers of drawing distinctions between these domains, as all these psychological processes are intertwined. The second criticism claimed the taxonomy provides only a means of classification, without supplying answers to questions of whether such objectives are part of what is meant by education and of whether they should be taught.

1.3.2 Curriculum Content

Rowntree (1982) noted that children learn through interacting with the environment, which is made up of people, objects and ideas. It is clearly important when designing an educational programme to provide the realistic experiences which will enable learning to occur. Therefore design of learning is a very complex activity which involves decisions about selecting curriculum content, sequences, teaching methods and strategies and presentation methods.

Curriculum content is influenced by a considerable range of factors. A most important one, as noted by Kelly (1977), is the social pressure and demand exerted by society that schools are satisfying its needs. Social pressures stem from the situation of schools being viewed as agents for the handling of societies culture. This creates difficulties about the definition of the term 'culture', as no uniform interpretation currently exists, within modern society, that is, no single pattern of life can be identified which can be considered as the culture of society. Further problems arise when attempting to make a selection from within a culture, also when establishing exactly what the relationship between society and schools should be.

Issues relating to curriculum content concern the very nature of knowledge and its validity, that is, its truth content, objectivity or intrinsic value. The two main forms of theory within Western European education are those of rationalism and empiricism. Numerous rationalist notions have been offered by such philosophers as Plato, Descartes and Kant, who propose that intellect is superior over other human faculties, and true knowledge is that which is achieved by the mind independently of the information provided by the senses. Conversely, empiricist views, claim no knowledge comes into the mind except via the senses. Such influences of this view of knowledge may be traced in the pragmatist approach of Dewey, who equates knowledge with experience.

The idea of choosing the content of the curriculum as a result of analysing the nature of the child is not new. Rousseau in the 18th century, along with Froebel and Montessori in the 19th century, first suggested this idea. In recent times the idea of child-centred education, as discussed by Kelly (1977), proposes three criteria by which to determine curriculum content, that is, the needs of the child, the nature of growth and the interests of the child.

1.3.3 Organisation of Curriculum Content

Having decided what is to be taught, issues relating to the sequencing and organisation of this content must be addressed. Rowntree (1982), identifies six forms of sequence:

- the chronological sequence, following issues in the chronological order in which they occur;
- the causal sequence, in which causation issues are addressed;
- the structural logic sequence, where consideration is given to the order in which a topic is covered in relation to another topic;
- the problem-centred sequence, whereby the sequence of ideas may be introduced by the pupils;
- the spiral sequence, where concepts are developed in each level of the spiral;
- the parallel theme sequence, where there is no necessary sequence at all, as the themes for exploration do not depend upon each other.

As a general principle, Rowntree (1982) suggests that the ideas pupils meet early in their education must not interfere with their later learning.

Tyler (1949), identifies three elements for the successful organisation of curriculum content, that is:

- Continuity, referring to the reiteration of major aspects in different classes in the curriculum.
- Sequence, stating that important curriculum elements must not simply recur, but develop further to higher levels within the curriculum.
- Integration, suggesting the organisation of various subjects within the curriculum must assist the pupil in gaining a unified view of the elements dealt with.

1.4 A NATIONAL CURRICULUM

1.4.1 The Introduction of the National Curriculum

The National Curriculum was introduced by the 1988 Education Act, which is the largest educational legislation reform since 1944. The 1988 Act, does not replace the 1944 Act but forms the legal basis for education within England and Wales. However, as noted by Dunford *et al.* (1990), it replaces the power bases within the education system, with an enormous power shift from local government to central government.

Attendance at school within the U.K is compulsory for children between the ages of 5 to 16. The school system for this age range, which is publicly financed, is arranged in either two or three tiers. In the two tier system, the primary stage, which is for ages 5-11 (except in Scotland where transfer to normally at the age of 12 not 11), is sometimes further divided into infant schools (ages 5-7) and junior schools (ages 7-11). This is followed by a secondary stage that involves selective or non selective secondary schools (ages 11-16 or 18). The three tier system is arranged as first schools (ages 5-8 or 9), middle schools (ages vary between 8-14, for example, 8-12 or 9-13) and comprehensive or high schools, usually non selective (age as 12/13-16/18). The two tier system, as noted by Hymas (1993) and DFE (1994), is the most common. The use of the three tier system is restricted to England, where it accounts for less than 15% of all children.

The 1988 Education Reform Act established the first National Curriculum for all state schools in England and Wales. This was perhaps the key aspect of the 1988 Act, representing considerable changes in the educational system within England and Wales, 'certainly the greatest as far as schools are concerned since the 1944 Education Act' (Welsh Office, 1989, foreword). The National Curriculum Council (1992) noted that 'the schools of the 1990's will be very different from the schools in which today's student teachers were educated', with the implicit and explicit changes likely to have long term effects on the education system.

The origin of the Welsh National Curriculum seems to have evolved from three main concerns fuelling demands for change, that is:

- a sense of a failing system and need to raise standards;
- a growing social demand for change to the education system;
- a clearly defined political purpose for change to the education system.

All three elements will be discussed within the course of the literature review as major elements for demanding changes within schools and educational systems over a considerable period of time within the United Kingdom.

1.4.2 The Raising of Standards

A widely accepted definition of school improvement stems from the OECD sponsored International School Improvement Project (ISIP), where Van Velzen (1995) states:

> *a systematic, sustained effort aimed at a change in learning conditions and other related internal conditions in one or more schools, with the ultimate aim of accomplishing educational goals more effectively.*

Fullan (1991) notes, 'persistence is a critical attribute of successful change.' Also, Huberman (1992) noted, 'no one says school improvement will be easy, smooth initial implementation is usually a sign of trivial change.'

Hargreaves and Hopkins (1991), and Bolam *et al.* (1993), state:

> *Successful school improvement is not restricted to teaching – learning activities but extends to supporting roles, relationships and structures.*

Concern had been expressed about the curriculum which some children within British schools were experiencing. For example, the NCC (1992) felt many had been deprived of a broad and balanced curriculum which specialised far too soon. Indeed, approximately three quarters of children left school without entering an examination in a science subject. Sixty percent or more did not study a foreign language beyond the age of 14. Additionally, there was strong gender bias, for example, very few boys learned a foreign language and very few girls took heavy craft subjects. Such widespread concerns led to calls for a change to the education system. The Reform Act as noted by the NCC (1992)

> *created the National Curriculum, which represents a turning point in the history of education in England and Wales. For the first time, a clear legal framework for raising standards in schools has been set.*

Hymas (1993) states, the Reform Act of 1988 introduced a curriculum which all state schools were required to follow, which many independent schools voluntarily adopted, which expressed what every child within compulsory school age should be working on in relation to their stage of development.

Another aim of the act was to increase differentiation between schools and encourage competition between them, such competition was introduced by the system of open enrolment. This enabled schools to enrol beyond the size limits previously determined by Local Education Authorities. Coulby (1990) noted:

> *Popular schools could thus increase their rolls and sprout mobile classrooms in their playground. The rolls of less popular schools were commensurately likely to fall and, in some cases, the future viability of schools is likely to come into question.*

The principle underlying this policy was based upon the notion that competing individuals made themselves strong and effective. In terms of primary education, the effective schools would be rewarded with more pupils and resources whilst the less effective schools would receive fewer pupils and resources and eventually close, making way for their more successful rivals.

1.4.3 A Growing Social Demand for Change

Since 1880 and the beginning of compulsory education in England and Wales, there has been no legal requirement, with the exception of religious education, on the school curriculum. The NCC (1992) noted that:

> *over that period there were growing concerns about standards, the variable performance of schools and inadequate information for parents and others.*

It was increasingly argued that parents who depended on state education for their children, no longer had the confidence that their children would receive the necessary education to equip them for the future. Prime Minister Callaghan (1976) found that complaints from industry were rising, that new recruits did not have the basics to complete the required job. This situation was seen from some quarters as a result of Local Education Authorities and teachers not responding to the needs of the children in their charge. Quick (1988), observed that one considered solution was:

> *to give more power to parents by giving them the right to choose the education which they feel is the most suitable for their children; and to lessen the power of the Local Education Authorities.*

Ball (1995) noted that education within the U.K. was in the process of fundamental change, at the centre of which was the National Curriculum.

The need to raise standards was cited as a reason for introducing the National Curriculum. Callaghan (1976) claimed:

> *owing to the increasing complexity of modern life we cannot be satisfied with maintaining existing standards, let alone observe any decline*

It appeared considerably more important for the next generation to receive a higher-level of educational experience than its predecessor. Clearly, this was welcomed by everyone. However, as noted by the DES (1991), there was considerable disquiet about the introduction of 'competition' within the education system, particularly for those families who are differentiated through income, status and ability to profit.

The call for change and the demands for a national curriculum may appear to have emerged during the 1970's. However, unrest with the education system may be traced back much further. By the 1960's the optimism and consensus within education that had been created by the 1944 Education Act was beginning to disappear. There was growing concern amongst teachers and within LEA's that central government wanted more control over the school curriculum. The education system within the U.K. had undergone difficult years, concluding in the consultative paper, 'The National Curriculum 5-16, A Consultation Document'. This was the forerunner of the 'Great Education Reform Bill' in the Summer of 1987. Simon (1992) noted this was preceded by many calls for change from politicians, psychologists, sociologists, teachers, parents, industrialists and the media.

Reynolds and Cuttance (1992) noted that many head-teachers were aware of the need for progress to be made. There was a need to change the existing culture and to align it with their vision for the school, and they argue that:

> *School improvement must deal with the culture of schools as well as with their structure. It must concern itself with the informal world of the school as well as with the formal world. It must concern itself with the deep structure of values, relationships and interpersonal processes as well as with the world of behaviour.*

The relationship between cultural change and leadership is complex. The key importance of leadership is stressed in a recent OHMCI (Wales) Report (James, 1998), in which the Chief Inspector of Schools stresses the importance of leadership at all levels:

> *In the endeaver to bring about improvements in all aspects of educational provision, nothing is more important than the quality of leadership in schools. Time and again, in schools that have reversed a pattern of declining achievement and low morale, the role of the head emerges as the most important factor. (OHMCI, 1998)*

These key factors are well established in change management literature (Alvesson, 1993; Bate, 1994; Martin, 1992; Jenkins, 1997).

1.4.4 A Clearly Defined Political Purpose for Change

Ball (1993) notes:

> *The most visible aspect of the conservative governments educational reform is the development and installation of the National Curriculum.*

Clearly this action was of key political importance during the time. However, Lawton (1993), criticises the system from:

> *the fact that many countries with centralised curricula were trying to free schools from too much central control.*

Simon (1989) indicates one of the aims of the National Curriculum was to:

> *strike out in quite new directions; primarily to break the 'monopoly' of local authorities, to substitute competition for co-operation as the motive force of change and to subject all schools to the free play of the market.*

Clearly, as identified by Ball (1993), two contradictory concepts were now at the centre of the reforms, that is, market forces and centralisation. The first devolved powers by developing parental selection as a key mechanism for allocation of resources. The second, through the National Curriculum, drew power and control of the curriculum to the centre under the control of central government.

A key aim of the 1988 Education Reform Act was to reduce the power of local authorities and eliminate their monopoly of control over education at a local level. Simon (1992) noted:

> *The attempt to swing the whole system to determination by market forces, to establish a market in education, has fuelled the move to deprive local authorities of their historic role as providers and planners.*

Some educationalists have been highly critical of the aims of the educational changes. For example, Ball (1993), is highly critical that:

> *Majorism in education is identified with a regressive Victorianism which is disconnected from and sets over and against attempts at educational modernisation.*

Furthermore, Simon (1992), notes many educationists argued that the conservative government's 'Great Education Reform Bill' in reality meant the systematic break-up of the state education system as developed from the 1944 Education Reform Act.

The period from 1977 to 1986 saw a considerable number of key publications, reports and documents, submitted all focusing upon the education system, the curriculum and school standards. Examples of such material are:

1977 Educating our Children (Conference paper), Education in Schools (The Green Paper).

1978 Special Education Needs - The Warnock Report.

1979 A Basis for Choice - The Mansell Report.

1980 A Framework for the School Curriculum.

1981 The School Curriculum, Circular 6/81, The Practical Curriculum.

1982 Basic Skills, Mathematics Counts - The Cockcroft Report, The Secondary School Curriculum and Examinations.

1983 Teaching Quality (The White Paper).

1984 The Organisation and Content of the 5 to 16 Curriculum.

1985 Better Schools (The White Paper).

1986 LEA Policies for the School Curriculum (Report on Review), Achievement in Primary Schools.

These culminated in the Education Reform Act of 1988. Coulby (1990) notes, the key elements underlying the introduction of the National Curriculum in its original form met with considerable approval from political and professional spheres. However, Proctor (1990) argued that the introduction of the national curriculum was not an agreed curriculum, it was clearly not the highest common factor of opinion from teachers, educationists, parents, industry or the wider community, rather it was:

> *a scheme produced by civil servants for politicians, and will constrain future educational development because of its formal and bureaucratic structure (ibid).*

Simon (1992) notes, clearly the government wanted to raise standards through testing, therefore a new educational system evolved where everyone are supposed to learn the same thing to be tested. Cambell (1993) argues 'the full delivery of the National Curriculum is impossible for normal teachers. The dream, became, or is becoming a nightmare.' Indeed, Simon (1992) considered the National Curriculum to be as the 'state curriculum'.

National Curriculum requirements may be considered as a useful motivational factor in moving schools forward, a view which is supported by research (Southworth, 1994; Webb, 1994). However, there is also evidence that failing and underachieving schools are improving after inspection. When reviewing improving schools (OHMCI, 1998) the Chief Inspector is quoted as saying:

> *In nearly all cases, the combination of the inspection itself, the implementation of post-inspection action plans and the related developmental work and monitoring of HMI has led to real improvements in the standards achieved by pupils and in the quality of education they receive.*

Indeed, as noted by OHMCI (1996/97):

> *We know that schools are improving and that there is evidence of a determination to raise standards.*

1.4.5 Wider Implications of the National Curriculum

Having considered the political and social pressures for curriculum reform, clearly, the National Curriculum was introduced as part of Government reform which altered the distribution of educational power in addition to educational organisation. Examples of additional aspects of reform are outlined by the NCC (1992), that is:

1. The development of grant-maintained schools, City Technology Colleges, and open enrolment enabling greater parental choice of school
2. More participation by the governing body in the statutory running of the school.
3. Introduction of a statutory curriculum and assessment.
4. Introduction of Local Management of Schools.
5. Introduction of teacher appraisal.
6. The use and focus upon the school development plan in terms of school improvement.
7. The increased role of the local and national inspectorate.

Lawton (1994) notes generally the idea of the National Curriculum was welcomed in principle, however it was distorted by the ideology of choice and market. Black (1993), noted that the chair of the Task Group on Assessment and Testing (TGAT), claimed:

> *no other country in the world has a system which gives such comprehensive control to its government over the curriculum with such a frequent and closely controlled system of national assessment.*

West *et al.* (1994) found that teachers lacked time for reflection, discussion and a loss of autonomy. Generally, most teachers did not oppose the concept of a National Curriculum, however, they were extremely concerned about workload, stress and were negative about the introduction of Standard Assessment Tests (SAT's). Riley (1992) observed:

> *The general intentions of the National Curriculum have met with professional approval. These principles will make it possible to achieve greater uniformity and continuity within and between primary schools.*

Whatever one's viewpoint on the development and introduction of the National Curriculum, clearly, as indicated by Simon (1989), the issue is so complex and far reaching, 'confrontation and conflict are likely to characterise the educational scene for some years to come'.

The implementation of the National Curriculum has been one of the most far-reaching reforms within education during the 1980's. However, Chitty (1993) points out it has been criticised as overloaded and too prescriptive. Bennett (1990) notes it has been argued that the structure of the curriculum has no research or theoretical base. The basic elements of the National Curriculum are described in the following sections.

1.4.6 The National Curriculum in Wales

The official description of the National Curriculum, as defined by the Welsh Office (1989), DES (1989), and Welsh Office (1994), is summarised as:

1. Foundation subjects, including three or four core subjects and six or seven other subjects which by law must be in the curriculum for all children.
2. Attainment targets, covering the age of 5 to 16 years of age defined as the knowledge, skills and understanding children are expected to attain at the end of each key stage.
3. Programmes of Study, outlining essential areas within each subject area, defined as matters, skills and processes to be taught within each subject area.

4. Assessment arrangements, defined as arrangements to assess children at or near the end of each key stage.

In order to understand the new curriculum system it must be seen within the context of the whole curriculum framework and the four points above need to be expanded.

The National Curriculum consists of 9 (in England) or 10 (in Wales) subjects, that is three or four subjects and six or seven other foundation subjects. The statutory subjects as described by the NCC (1992), within Key Stage 2 are outlined in Table 1.1.

Table 1.1: Subjects within the Welsh National Curriculum

Subjects	**Name of Subjects**
Core Subjects	Mathematics
	Science
	English
	Welsh (First Language)
Foundation Subjects	History
	Geography
	Technology
	Welsh (Second Language)
	Art
	Music
	Physical Education

Hymas (1993) notes the core subjects are so described because 'they are the most important skills children are expected to master'. They comprise of essential knowledge, concepts and skills which enable other learning to occur. The foundation subjects offer the range of knowledge, skills and understanding which is considered to be a broad, balanced curriculum for each child. Additionally, four key stages with associated year groups based upon the majority age of pupils at the end of the school year have been determined by the Education Reform Act, these are seen in Table 1.2.

Table 1.2: Key Stages and Year Groups

Key Stages	Year Groups	Age of the majority of children at the end of each school year
	R	5
1	Y1	6
	Y2	7
2	Y3	8
	Y4	9
	Y5	10
	Y6	11
3	Y7	12
	Y8	13
	Y9	14
4	Y10	15
	Y11	16
	Y12	17
	Y13	18

These subjects, it must be noted, are not the total of the Curriculum offered to children. The whole curriculum, as seen by the NCC (1992), involves section 1 of the Act, which involves:

1. Economic and industrial understanding of the environment.
2. Careers education and guidance.
3. Health education.
4. Aspects of personal and social education for citizenship.
5. Environmental education and conservation.

Therefore, as Pring (1989) summarises, the curriculum is based upon the following five principles:

1. Breadth, that is contact with the subject areas outlined in Table 1.1.
2. Balance, that is appropriate attention given to an allocated time of learning for each subject.

3. Relevance, that is the curriculum to be seen by the children to meet their present and prospective needs.

4. Differentiation, that is relating what is taught approximately to the different ability and motivational needs of the range of children in a class.

5. Progression and continuity, that is with coherence from stage to stage in planning and experience from 5 to 16 years of age.

To enable the drafting of the Attainment Targets and Programmes of Study, the Secretary of State set up subject working groups. The timetable these groups worked to is given in Table 1.3.

Table 1.3: Working Groups Timetable

Subjects	Working Groups set up	Proposals Published
English 5 – 11	April 1988	November 1988
English 11- 16	April 1988	June 1989
Mathematics	July 1987	August 1988
Science	July 1987	August 1988
Technology	April 1988	June 1989
History	January 1989	July 1990
Geography	May 1989	June 1990
Foreign Language	August 1987	October 1990
Welsh	May 1987	1990
Music		1992
Art		1992
Physical Education	July 1990	April 1992

Maw (1988), when considering the period of consultation on each of the proposals after publication, found it unfortunate no reference is made to the curriculum views of HMI in the consultation framework.

The key areas of mathematics within the National Curriculum, as outlined by the Department of Education and the Welsh Office (1991) are, number, algebra, measurement, space and shape and handling data. Attainment targets at 10 different levels were specified in each of these areas as follows:

Attainment Target 1: Using and applying mathematics.
Attainment Target 2: Number.
Attainment Target 3: Algebra.
Attainment Target 4: Shape and Space.
Attainment Target 5: Handling data.

Alexander *et al.* (1992) points out the four teaching roles that are necessary for the delivery of the National Curriculum, that is, the generalist who teaches across the curriculum, the consultant who provides cross school co-ordination of particular subjects, the semi-specialist who teaches a specific subject in addition to a general class teacher role and the full-time specialist who teaches one specific subject only.

Alexander *et al.* (1992) considering pedagogy, stated more subject teaching and, where appropriate, more whole class teaching was required. Overcoming the danger of pitching to the middle level, whole class teaching is associated with higher order questioning, explanations and statements, these in turn correlate with higher levels of children's performance. However, most serious is the concern of the ability of some teachers to effectively deliver the new curriculum in total. Wragg *et al.* (1989) noted on this issue that one quarter of all teachers claimed they would need substantial in-service support in order to confidently teach these subjects to the appropriate levels.

Kelly (1990) also identified problems when noting the planning of the National Curriculum has ignored what has been learnt about the education of pupils with special needs, when implementing its integration policy.

Within the Act, the head-teacher has responsibility for the organisation of the curriculum and ensuring the implementation of the National Curriculum. The responsibility of ensuring the existing schemes of work cover the attainment targets and programmes of study, lies with the head-teacher, though many staffs will have a member fulfilling a co-ordinators role who in conjunction with the head-teacher develop schemes of work, along with suggesting resources for an area of the curriculum in which they will have some expertise. Class teachers would be responsible for meeting the obligations of National Curriculum requirements within their daily teaching requirements. Additionally, they need to follow the specific directions indicated in the whole school documents.

The introduction of the Attainment Targets and Programmes of Study for each of the foundation subjects occurred on a phased basis over a period of years. This timescale may be seen in Table 1.4.

Table 1.4: Timetable for Introduction of NC Attainment Targets and Programmes of Study

Subject	School Term	KS1	KS2	KS3	KS4
English	Autumn	1989	1990	1990	1992
Maths	Autumn	1989	1990	1989	1992
Science	Autumn	1989	1990	1989	1992
Technology	Autumn	1990	1990	1990	1993
History	Autumn	1991	1991	1991	1994
Geography	Autumn	1991	1991	1991	1994
Art	Autumn	1992	1992	1992	1995
Music	Autumn	1992	1992	1992	1995
PE	Autumn	1992	1992	1992	1995
Foreign Language	Autumn			1992	1995
Welsh					

1.4.7 Assessment within the National Curriculum

Curriculum and assessment methods are closely related within the framework of the National Curriculum framework within the 1988 Educational Reform Act. Riley (1992) noted:

> *it is the provision for assessment which gives the curriculum measures their power.*

The key emphasis on assessment is based upon raising standards. Within the Consultation Document (DES, 1987), it implied assessment would raise standards of attainment by:

- Setting clear objectives for what children over the full range of ability should be able to achieve, thereby assisting schools to enable the development of all children to their fullest potential.
- Checking on progress made at various stages, allowing extension material when required, with consolidation and support material given where appropriate.

In the current situation, the assessment programmes is the controlling mechanism within the National Curriculum Framework. The DES (1989) commented within a bulletin, assessment should be the servant not the master of the curriculum.

The framework for the formal testing of children in the core subjects at the ages of 7, 11, 14 and 16, according to Kelly (1990), is the most salient and significant feature of the National Curriculum. Regarding the process of assessment Lawton (1989) noted it would be wrong to use the tests as a means of reinforcing the National Curriculum. However as a result of this assessment framework and its relationship within the National Curriculum, Kelly (1990) states, there is little doubt that 'the National Curriculum is an assessment-led curriculum'.

Children will be assessed at the end of each key stage. Initially, the assessment framework covered the core subjects, that is, mathematics, English and Science, however over time, assessment would be introduced to cover all of the foundation subjects. Assessment would be of two forms, first teacher assessment and secondly assessment based upon children's performance in the Standard Assessment Tests. Statham *et al.* (1991), outlined 'where there is disagreement between the results of the two forms', procedures must be established to reconcile such differences.

Kelly (1990) considers the National Curriculum not to be a developmental curriculum, rather, an instrumental curriculum which is concerned with outcomes which requires summative evaluative techniques. As a result of the National Curriculum being controlled from the centre, formative evaluation, which involves a mechanism for change, adaptation and development does not exist. The DES (1989) indicated that the results of tests and assessments should be used formatively to help better teaching and to inform decisions as the most appropriate way ahead to develop a child to the fullest potential possible.

The introduction of the National Curriculum and its assessment framework developed considerable controversy in some quarters culminating in a teachers boycott of the assessment arrangements during the first stages of their introduction. The Secretary of State for Education asked Sir Ron Dearing in April 1993 to undertake a review of the National Curriculum and its assessment framework reporting back in the December of that year. Regarding assessment arrangements the Final Report (1993) suggested:

1. The tests in the core subjects should be simplified as far as possible without sacrificing validity and reliability, with the time taken to administer the tests cut further.

2. The systems of moderated teacher assessment must guarantee standards but must not be bureaucratic nor excessive in their demands on teacher time.

2. The systems of moderated teacher assessment must guarantee standards but must not be bureaucratic nor excessive in their demands on teacher time.

3. Statutory teacher assessment beyond the core subjects within primary schools should not be required until the curriculum had been slimmed down.

4. Further advice on record keeping should be of help to primary schools.

Since the National Curriculum was introduced in 1989 it will take 11 years for the first cohort of children to pass through the whole of the system. Kelly (1990) notes the dangers of accepting the view that evaluation must wait until the year 2000, and states:

> *evaluation is limited to an assessment of the outcomes of this curriculum or, even more narrowly, to an appraisal of the extent to which it had been successfully delivered.*

This chapter and indeed literature review, gives an indication of the nature and diversity of opinions and philosophies held by a range of researchers. In some instances their standpoints may appear to be contradictory or even paradoxical. However, these differences are included throughout the literature review to demonstrate the extent of legitimate diversification that currently exists and is supported within the UK educational system. Such a variety of theories and practices are important, valid and applicable to a wide range of specific circumstances and situations, and are undoubtedly influenced by the emphasis placed upon them by individual writers.

Within this dissertation the different viewpoints and philosophies held by researchers have been presented without any bias towards one given ideology or educational philosophy.

CHAPTER 2

MATHEMATICS WITHIN THE SCHOOL CURRICULUM

2.1 MATHEMATICS AND THE SCHOOL CURRICULUM

2.2.1 Introduction

As a result of developments within the Primary Education System of England and Wales, mathematics, as discussed by Howard *et al.* (1968), has been given a distinguished, elevated status within the school curriculum. The pace of educational change and technological development, particularly during the previous thirty years, demanded considerable importance being attached to the learning of mathematics within schools and in particular, more emphasis focused upon individual pupils' levels of achievement.

The Primary Survey (1978), commented:

> *Teachers, parents and others are inevitably and rightly concerned with standards achieved by children in school. It must however be recognised at the outset that there is no one standard which is appropriate to all children at a given age. Individual children vary in their capacities and abilities.*

In past decades, arithmetic and basic mechanical number operations has been the main syllabus for many children, this consisted mainly of learning arithmetical facts by rote. However, as the demands of society and industry grew, particularly from 1960 on, so did the need for a more mathematically functional work force. This has resulted in the development of mathematics within schools, with arithmetic operations becoming a sub-section of the mathematics syllabus.

Supporting this demand, the DES (1978) surveyed primary schools in England, focusing attention on the quality of education for pupils aged 7, 9 and 11. In mathematics, they concluded:

> *the subject was given a high degree of priority in the curriculum of the primary school.*

Whatever reasons may be proposed for the teaching of mathematics within schools, its usefulness is clearly recognised by Cockcroft (1982):

> *We believe that all these perceptions of the usefulness of mathematics arise from the fact that mathematics provides a means of communication which is powerful, concise and unambiguous.*

The DES (1989), stressed that in schools where good practice was identified:

> *Mathematics had a central place in the curriculum. Without exception the teachers were concerned that their pupils should be competent in using mathematical processes.*

2.1.2 The Curriculum Concept

When discussing the curriculum generally, and mathematics teaching specifically, it must be established at the outset that there is considerable difference between the terms 'curriculum' and 'syllabus'. Initially, curriculum had been accepted as a course of study, and gradually this developed to encompass everything relating to the teaching and learning processes within a school environment.

Lewis and Miel (1972) defined a curriculum as:

> *a set of intentions about opportunities for engagement of persons to be educated with other persons and with things (all bearers of information, process techniques and values) in certain arrangements of time and space.*

Saylor and Alexander (1974), defined a curriculum as:

> *a plan for providing sets of learning opportunities to achieve broad goals and related specific objectives for an identifiable population served by a single school centre.*

They represented the curriculum (see Figure 2.1), as a plan consisting of a series of educational continuums, developed, implemented, and evaluated for a particular school. This curriculum plan is sandwiched between INPUT (i.e., students to be educated) and OUTPUT (i.e., school leavers, who may choose to continue in other places of learning).

INPUT --------> {THE CURRICULUM - A PLAN} ---------> OUTPUT

pupils to be taught school leavers/graduates

Figure 2.1: The Curriculum Concept

The curriculum model of Saylor and Alexander contained a range of elements that were produced as part of a total plan where the curriculum anticipates the provision of learning opportunities for a specific set of objectives within a given population.

The curriculum system outlined and considered here, is organised on the basis of sets of educational continuums, each set relating to a curriculum domain (or subject area), describing a group of planned learning opportunities designed to achieve a set of closely related educational aims along with associated and related objectives. This technique of curriculum management may be compared with Management By Objectives (Handy, 1985), a technique which has been developed and implemented throughout many of the schools in the primary education sector within the UK.

There are three traditions within British schools that have historically influenced curriculum development. These are:

- preparatory tradition;
- elementary tradition;
- developmental tradition.

The elementary tradition originated in the nineteenth century, when 'elementary education' was urgently needed to develop basics in literacy and numeracy. Consideration of the basics were further enhanced in the preparatory system, which went on to equip the children of the time, with the skills considered necessary for future use and application. It was stressed in the Crowther Report (1959), that:

> *It is not the training in particular skills but the development of general mechanical ability that will make adaption to the changing requirements of industry a relatively easy matter, a flexibility that will be brought about only if teachers concentrate less on the inculcation of knowledge and more on the acquisition of understanding.*

The developmental tradition attempts to recognise the needs of the individual pupil and builds the curriculum around these needs. Any evaluation or consideration of contemporary educational practice and curriculum development, must take these three dynamic traditions into account. So crucial is the concept of the curriculum within education that its development is discussed in detail in Chapter 1.

2.1.3 Ensuring continuity in the Teaching of Mathematics

When planning and organising mathematics teaching within Key Stage 2 it is important that the work set is based upon an understanding of the needs, difficulties and interests of the children. Also the teacher must consider factors relating to any individual differences between pupils. To ensure pupil progression and continuity in learning mathematics, Tansley and Gulliford (1960) suggested five key procedures to be undertaken within schools, these being:

- activities planned, should develop habits of self-direction and independent learning;
- subjects must be well taught in relation to readiness and motivation, hence arranging appropriate work to give each pupil a feeling of success;.
- learning to be independent;
- developing the ability to be self critical;
- to be responsible for their own actions.

Howard *et al.* (1968) contends effective mathematics teaching devotes a reasonable amount of time to enable pupils to discover mathematical concepts. These learning opportunities are often created through class, individual or group discussion and questioning methods where a balance needs to be met. The DES (1978) stated:

> *insufficient time was given to discussion and to direct teaching of a whole group or class.*

In a Bulletin of the Nuffield Mathematics Teaching Project, which structured its work and activities according to pupil readiness, in Mathematical Forum', Mogford's (1966) view was:

> *If as teachers we can foster this curiosity, guide the children along their avenues of investigation, and share with them the joy of discovery, then teachers shall ensure that in our primary schools real learning, 'active learning' is taking place.*

In addition, giving the same activity to all pupils in a class simultaneously is seldom justifiable (Corle, 1964). With the help of the teacher, appropriate materials and tasks can be selected and completion time allowed. It is as a result of this form of differentiated task or activity that individual pupils within a class are motivated to improve their level of mathematical competency, where their individual needs may be met and progression ensured.

Bloom (1976) believes that learning will be more effective if pupils are:

> *allowed and do spend the necessary amount of time on a learning task. There is little doubt that students with high aptitude levels are likely to be more efficient and require less time for learning than students with lower aptitude level.... An effective learning mastery learning strategy must find ways of altering the time individuals need for learning as well as providing the time necessary for each student.*

A wide variety of methods are available for teachers to establish the extent to which pupils are progressing and achieving set goals and targets which match their individual needs. Testing the pupils supplies important information and feedback (Schonell, 1937). The results of tests prevent further work being attempted where the fundamental operations are still not sufficiently understood, such test results should:

> *reveal on testing and in a comprehensive way, the exact level reached by his pupils and the precise nature of their difficulties.*

Further, Doubay and Douglas (1973) considered the use of tests as a powerful tool for helping mathematics teachers to become more efficient and more effective. They are, according to Anastasi (1976):

> *an aid in describing and understanding the individual, identifying his problems and reaching appropriate action decisions*

Testing assists effective teaching by increasing individual achievement; tests are also a means to:

- improve pupils' learning;
- aid self-improvement;
- give opportunities to discover what a child knows and does not know, in order that he can be helped to learn the unknown and correct, previous errors.

Jackson (1974), outlined the purposes of tests in mathematics teaching as:

- to compare pupils' abilities in order to allocate them into teaching groups or classes;
- to estimate individuals progress;
- to measure learning abilities of children;
- to diagnose difficulties in a particular process.

The DES (1984), when considering mathematics in the whole curriculum noted:

> *Mathematics should provide both a challenge and a sense of achievement for all pupils. That is, all pupils should be extended but no pupils should be so extended that they largely experience failure. To achieve this requires professional judgement in setting tasks which are differentiated according to the pupils involved.*

The importance and demand for assessment has grown considerably throughout the past decade. Full discussion of the concept of assessment and its implications for education are to be found in Chapter 3.

2.1.4 Effectiveness of the Mathematics Teacher

Without doubt teachers play a vital role both in promoting learning, and critically in influencing their pupils attitudes towards the subjects taught. It is arguably the teacher that is more important than the material or method used in curriculum delivery. Evans (1959), stated:

> *the most important people in any educational system are teachers in the classroom .... teachers come into contact with and help to educate far more children than any group of people, and their influence upon the rising generation can be very great and must not be underestimated.*

Barr (1948), Ryans (1953) and Travers (1953), maintained that effective teaching methods provide pupils with the mechanisms which are conducive to the development of skills, understanding, creative expression and desirable attitudes. These factors further contribute towards the continual growth of pupils' mathematical achievement.

Jenkins (1951) stressed that for effective teaching to occur, the children must be:

- helped to learn and think for themselves, hence developing their intellectual power;

- given effective ideas and techniques which are necessary to continue the process of educating themselves;

Thus an element of independent learning methods need to be introduced and developed by the learner. It is as a result of such methods that children begin to accept responsibility and independence for their own learning.

Coleman (1963) identified key aspects of teaching arithmetic as:

- helping children to think for themselves;
- consistently develop good learners of arithmetic, recognising that experience must precede or accompany the language that is used;
- encouraging the development of rules and generalisations through past and current experiences;
- to enable children to evaluate their own work.

According to Fehr (1963), good teaching acknowledges efficient methods which use current trends and developments in mathematics, whilst constantly adapting itself to the maturity and past experiences of the pupil.

Bloom (1964) outlined effective teaching as pupil involvement and usage in:

- concepts and generalisations;
- proper attitudes towards mathematics;
- good methodology in attacking problems;
- developing self-confidence.

whilst Corle (1964) contended:

> *the real test of a good teacher is her ability to extend differences in the children she teaches, to encourage and*

> *develop uniqueness when it appears, and to work comfortably within the limits of every pupil's potential.*

It is argued that effective learning experiences for children within primary schools lies directly with the level of professionalism displayed by the individual teacher in the classroom situation, that is, at the point of subject delivery. This was stressed by Taylor (1970a), who stated:

> *the effectiveness of any educational system depends on the quality of the teacher in the classroom.*

He concluded that classroom teachers are the pivot of educational activities. Thus it is crucial when planning learning activities that the three organisational dimensions of method, formulation and content are clearly understood, implemented and developed. Gillett (1962) identified effective teaching of mathematics as the ability to enter into the pupils' experience, identify the children's interest and lead them on to higher levels of achievement and creativeness, whilst Bloom and Foshay (1967) considered the teacher as a 'powerful force' in determining the quality and quantity of educational achievements as a result of the tasks and experiences supplied by the teacher and carried out by the children.

To enable successful mathematics teaching and maintain pupil's interest in the subject, Bruner (1966) states that it is essential that the relevance and aims of mathematics teaching are made clear, also that the material is carefully selected and adapted to the children's stage of readiness. The children must learn to think mathematically, being openly encouraged and allowed to consider matters, in addition to participating in the process of knowledge setting. Roa (1967) viewed effective teaching as the training of children to:

> *think and reason for themselves in order that they may be in a position as adults to examine carefully and appraise in a judicial spirit, the many forms of mass suggestion which will inevitably meet them in later life.*

Gattegno (1971) went further, indicating effective mathematics teaching is largely dependent on using different methods of teaching with different pupils, as well as subordinating the teaching process to the learning process. Rogerson (1975), suggests effective mathematics teaching:

- treats children as individuals, and employs activities which are designed to give satisfaction and pleasure, whilst achieving set goals;
- helps children use apparatus and equipment frequently; that is, engages in concrete activities where appropriate;
- encourages children to use intuition in creative, experimental and discovery work;
- relates mathematical activities to the child's past experiences, and presents opportunities for future developments. That is, build upon what is known by the pupils, then extending into areas of the unknown.

The DES (1978), however, noted in primary schools that:

> *Insufficient use was made of opportunities to link mathematics and other subjects of the curriculum including science.*

Clearly, effective teaching must involve pupils' understanding of the work undertaken. A concise notion of 'understanding' is given by the Cockcroft Committee (1982):

> *Understanding in mathematics implies an ability to recognise and to make use of a mathematical concept in a variety of settings, including some of which are not immediately familiar.*

Recent developments in education have seen particular emphasis placed upon teacher and school effectiveness. So crucial is this debate for current educational philosophy and school organisation, 'effectiveness' is discussed further in Section 3.3.5.

2.1.5 Using Mathematical Objectives Within the Curriculum

For many years researchers and educators have paid considerable attention to developing clear, positive objectives (see Wood, 1968), in attempts to improve the delivery and quality of the mathematics curriculum. For classroom purposes objectives are developed from general aims or statements of intent. For example, Cockcroft (1982, p.107) identifies 'an excellent set of aims' in Mathematics 5-11 (1979). These are said to have developed from the statement:

> *We teach mathematics in order to help people to understand things better - perhaps to understand the jobs on which they might later be employed, or to understand the creative achievements of the human mind or the behaviour of the natural world... Finally, there is the over-riding aim to maintain and increase confidence in mathematics....*

To identify mathematical objectives, Horn (1951) recommended the following criteria be further developed and implemented:

- Computational Skill, that is, the ability to use number operations;
- Number Sensitivity, that is, to use and apply number activities in real situations, both in and outside school;
- Mathematical Understanding of:
    - fundamental operations
    - arithmetical relationships
    - measurement and its process
    - arithmetical generalisations
    - vocabulary, that is, the use of and relationship between technical terms
    - meaningful concepts, for example, of quantity, number systems, whole numbers, decimals and so on.

Fehr and Phillips (1967) noted a clear system of outcomes resulting from the delivery and practice of primary school mathematics teaching. They identified three types of outcome:

- the development of problem solving capability;
- the development of a range of skills in using, and applying mathematical symbols and concepts;
- the acquisition of fundamental concepts critical to the learning and understanding of mathematics. That is, children:

    i. develop the ability to see relationships among these concepts;
    ii. learn to express concepts in words and at a later stage, in symbols.

In addition to these objectives, Taylor (1967) related the aims of primary mathematics closely to the general aims of education. This relationship is supported by Cockcroft (1982, p. 107). These objectives assist pupils to:

a. acquire the mathematical skills necessary for competence and self-respect;

b. gain the additional skills required for the future;

c. develop and appreciate the qualities needed for life;

d. think clearly and express thoughts more precisely using numbers;

e. enjoy their intellectual powers and to develop an aesthetic appreciation of mathematics.

Currently within the primary stage of education, particularly for children within Key Stage 2 mathematics, schools must produce opportunities where children experience a wide variety of learning methods, where they learn to think, do and explore their environment using a range of concrete materials in real situations.

Bloom (1964), Wood (1968) and the Mathematical Association (1976), developed and considered educational objectives under six headings, (see Figure 2.2). Considering these further, each section relates to children's development in:

1. *Application*, that is, to use abstractions, such as general ideas, principles and ideas, in real life activities and situations.

2. *Comprehension*, that is, the ability to *translate* between verbal and symbolic statements, to *interpret* by recording or re-arranging material or to *determine* consequences.

3. *Knowledge*, including specific facts, methods, conventions and principles.

4. *Analysis*, that is, the skill and ability to break down a situation into its constituent parts and then apply knowledge as a means of understanding each part.

5. *Evaluation*, the forming of judgements about the value or worth of information considered or methods used, or to compare a piece of work with other similar examples.

6. *Synthesis*, the putting together of constituent 'parts' to form a whole. This would involve the ability to propose and test hypotheses or develop a method of deduction from a given set of situations.

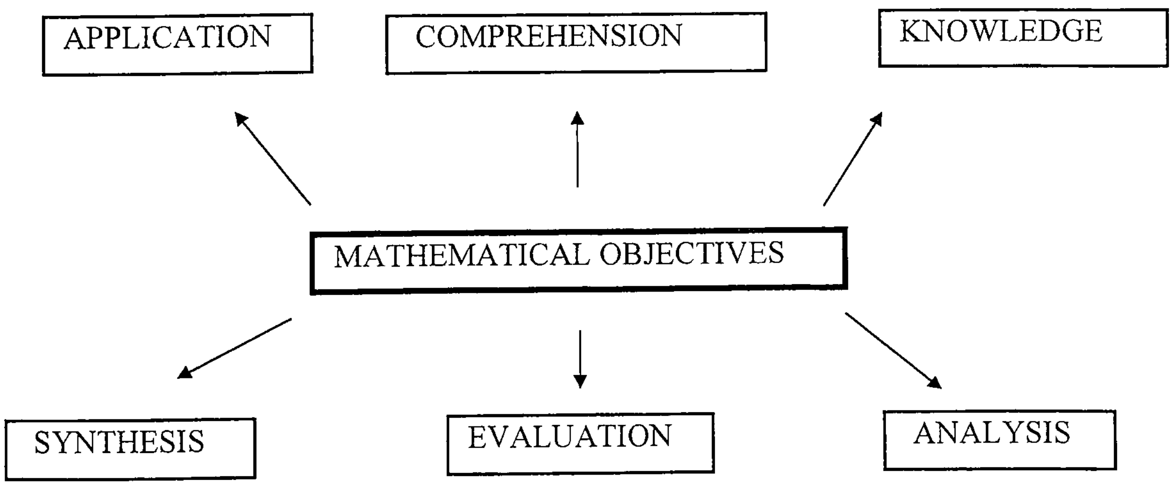

Figure 2.2: Mathematical Objectives

In Fraser and Gillan's (1972) discussion of mathematical objectives, pupils are required to show their:

- ability to calculate the operations of mathematics;
- ability to use mathematical instruments;
- skills in constructing geometrical shapes and freehand drawing;
- skills in sketching geometrical figures.

Further work by Crawford (1975) concluded that the aims of primary school mathematics teaching should require pupils to:

- become familiar with the basic concepts of number, shape, and the derived concepts of mapping and relations;
- develop the ability to think logically and generalise explicitly from simple patterns;
- appreciate the meaning and significance of mathematics.

The DES (1978) noted within the primary schools of England and Wales:

> *considerable attention was paid to computation, measurement and calculations involving sums of money but many children were unable to apply these skills in everyday situation.*

The Schools Council (1977) arranged clearly the objectives for teaching mathematics (see Figure 2.3) into three distinct categories: Considering these categories further, General Objectives may be sub-divided into four categories that are intended to assist children:

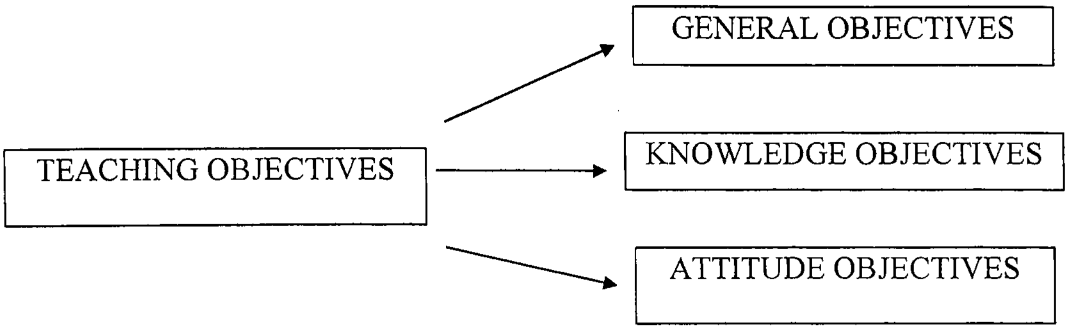

Figure 2.3: Teaching Objectives

i) select and apply techniques and strategies to unfamiliar situations;

ii) understand the mathematics involved in a given situation;

iii) argue inductively, make conjectures, verify situations and generalise;

iv) provide primitive justification, and deductive argument within a given situation.

Knowledge Objectives also contain four sub-categories:

i) mathematical concepts, terminology, notation, facts, generalisations, methods and techniques;

ii) the ability to understand and interpret mathematical information;

iii) the ability to apply knowledge to solve problems;

iv) the ability to translate mathematical information.

Finally, Attitude Objectives. These may be sub-divided to include the development of:

i) an appropriate attitude towards mathematics, including confidence, attention, with a willingness to learn mathematics;

ii) an ability to experiment and display the results of such experimentation;

iii) an ability to formulate questions;

iv) an appreciation of the significance of mathematics.

The DES (1989) noted that where mathematics work in schools was considered to be good, 'the school had a clear curriculum policy for mathematics'.

The previous classifications clearly have many common areas of agreement and overlap. It is these areas of agreement that allow the researcher to construct a framework based upon the continuously changing dimensions of method, formulation and content within the curriculum generally, and within Mathematics Key Stage 2 specifically, which will be used in the development of the research instrument used for the survey study.

2.1.6 Identification of Pupils' Difficulties

The process of identifying areas of learning difficulties is a key process within effective teaching of mathematics in the primary school. It considerably assists the teacher, in terms of preparation and delivery of material, to have clear ideas about the problems faced by individual children. Myere (1935) explains the significance of systematic errors from the perspective of prevention and cure:

- the detection and correction of systematic errors as early as possible is better;
- correction of errors allows the learning of the correct response by the pupil;
- emphasis on accuracy and control will develop clearer understanding of the subject matter involved.

Schonell and Wall (1949) paid particular attention to the fundamentals of effective mathematics teaching . They found:

> *a systematic attack on the child's difficulties, based on brief periods of teaching and practice is necessary. The purpose of this is made clear to the pupil, he is set immediate and attainable objectives, and he records his own progress on a personal chart. This is the framework without which achievement might be sporadic or slight.*

Indeed, without motivation and drive, Fehr, 1955 argued that no real learning can take place. Teachers who show concern and attention to the teaching environment do much to motivate pupils' learning. When motivation is present children will participate intuitively in the process of self instruction. Developing from this Bloom (1976) indicates that:

> *the key to the success of mastery learning strategies largely lies in the extent to which students can be motivated and helped to correct their learning difficulties at the appropriate points in the learning process.*

Adler (1966) noted a method to help children overcome difficulties or errors is that of providing them with suitable and relevant experiences which exposes the errors made and, following identification of these errors, facilitating work which corrects these mistakes.

The effective teaching of pupils requires more attention and consideration of the stage and level of readiness reached by the pupils in their experience of mathematics. Brennan (1974) indicated that:

> *readiness tests should be used to determine readiness of pupils for new work, and individual differences in rates of growth should be provided.*

The DES (1978) cited within primary schools:

> *for average and less able children the work in mathematics, together with that in reading, was more consistently matched to children's capabilities than their work in any other area of the curriculum: however, for the most able children, the work was often too easy.*

A decade later the DES (1989) noted of assessment techniques used:

> *this information was used to shape the activities as well as to identify the need to teach particular skills.*

2.1.7 Mathematical Remedial Work

There are many children who appear to be unable to perform the most basic of mathematical operations efficiently and accurately. Clearly there is need for new approaches to be developed which will overcome the difficulties found by these children.

Schonell (1937) indicated two approaches which a teacher could use to deliver the syllabus and meet the objectives set to eliminate further errors by pupils:

1. *Diagnostic tests*: The pupils work all combinations and from the results the teacher can tell what degree of mastery of these fundamental facts has been attained by each pupil. He learns what are the individual failings and whether they are numerous or isolated; and he learns what, if any, are the failings of the class as a whole. With this information before him he can determine whether or not the pupils can reasonably be expected to succeed with more difficult examples.

2. *Knowledge of common errors in the fundamental processes*: The most useful way of obtaining an insight into pupils' arithmetical methods is to ask him to work aloud a number of significant examples from the diagnostic tests, including steps where he has made errors. Methods of working, especially in addition, but also in all sums where more difficult number combination are involved, should be noted.

Schonell and Wall (1949) state mathematics teaching in primary school should be direct in order to be effective. Intensive practice, for example, of number games which involve the combinations or processes to be taught should be provided. This should include self-checking devices of various kinds, co-operative work in pairs or small groups, and the ability of pupils to concentrate on one thing at a time should be fostered.

Lloyd (1953) stated the basic principles underlying effective remedial teaching in mathematics are:

- to find out for themselves and overcome some of their difficulties;
- to develop the use of their talents and capabilities;
- to integrate their personality through free expression, play and creative work;
- to recognise their own needs.

Weaver (1954) insisted that any effective programme of tasks of a differentiated nature should include provisions for evaluation, diagnosis and appropriate remedial work. These are not additions to the teaching programme, but rather they should exist as part of the whole learning strategy.

Brueckner and Bond (1955) stated the basic principles considered necessary for effective remedial teaching in mathematics are:

- considering the needs of each child and then, adjusting the work given to meet those needs;
- to focus direct attention upon specific difficulties;
- continual diagnosis to improve methods of working;
- to develop and sustain the interest, confidence and co-operation of the individual.

Schonell and Schonell (1957) indicate how teachers may help the children to overcome their difficulties:

> *Some of them require remedial teaching of a special kind to overcome their difficulties, but all of them need the same kind of sympathetic encouraging approach to produce early success and to dissipate the effects of past failure.*

Rebec (1972) showed that for a teacher to be effective, the task of identifying pupils who are unable to keep pace with others in mathematics learning must be undertaken. These children should then be provided with adjusted material, thus attempting to remedy their deficiency in computational skills.

Brennan (1974) considered that corrective education should provide programmes which are designed to enable pupils to overcome their difficulties. Successful remedial teaching would require:

- assessment of abilities;
- definition of needs.
- observation and recording of progress as a basis for continued support and development.

According to Westwood (1975), teachers must:

- identify stages of development reached by the pupils;
- critically examine the pupils' work;
- record mastered skills;
- prescribe appropriate remedial procedures.

Brown (1976) maintained that constant feedback of knowledge ensures the teacher is aware the teaching process should be constantly modified to suit the individual needs. Therefore:

> *the need for continuous assessment linked with educational treatment.... and remediation must be considered on an individual basis, making use of many available approaches.*

Griffen (1978) indicated that the diagnosis of learning difficulties and effective teaching are interdependent and it is essential to:

- examine the child's difficulty as early as possible;
- use the information gained initially to locate the pupils' difficulties;
- look for more indicators to a child's problem;
- modify and adjust the teaching methods where necessary.

The DES (1978) indicated:

> *the extensive use of individual assignments, often using textbooks and work-cards, resulted in some children repeating known processes rather than being taken on to the next stage of their learning.*

2.2 MATHEMATICAL DEVELOPMENT WITHIN THE CURRICULUM

2.2.1 New Perceptions of School Mathematics

Romberg (1992) suggests that a new dynamic view of mathematics is being introduced into schools. The aims of this are to empower learners to develop their own mathematical knowledge, to enable all children access to concepts, and to align the social context in which mathematics is applied into the classroom. The older, rigid view of school mathematics being a set of rules to be learnt, a fixed body of knowledge, is being replaced, according to Gravemeuer (1994), by the idea that mathematics is a process in which children must engage.

This perspective of mathematics is rooted in the principle of it becoming a vehicle for developing and improving skills that are vitally important, not simply in other areas of the curriculum but in the routines of everyday life outside of schools. For example, mathematics may be 'used' in problem-solving situations, in communicating, with the use of new technology and as a means of developing positive attitudes. These ideas based upon the work of Dorfler *et al.* (1986), Stepelman (1993), Natsoulas (1995), Philippou *et al.* (1995) and Brolin (1987), will be discussed in detail in the following sections.

2.2.2 Mathematics as Communication

Cockcroft (1982) saw mathematics as a 'means of communication that is powerful, concise and unambiguous'. Communication in mathematics involves discussion within class, group and individual situations; communication between teacher and children to enable diagnoses; discussion within group work to enable progress; with the process of communicating results and evaluation of methodology a key element of self improvement.

2.2.3 The Integration of Mathematics

The basis of mathematical integration is, according to Natsoulas (1995), to enable children to see the relationship between aspects or ideas of mathematics and the whole subject. Also to recognise the place of the subject (mathematics) within the whole curriculum, or the whole range of subjects available. This concept of mathematics teaching as identified by Siemon (1983) seemed to occur in the 19th century throughout Europe. It related initially to an integrated treatment of plane and solid geometry. Willoughby (1983) noted significant progress was made on the integration of mathematics with the introduction of the new maths era.

A major principle of mathematical integration is the value of mathematics as a unifying subject; the fact that it should not be perceived as a discipline studied for its own sake. Rather, as noted by Davison *et al.* (1995), because mathematics will enable meaning to be brought about for other aspects of our world. Consequently, the relevancy and usefulness of mathematics to the children's experiences should be maintained. The integrative approach to teaching mathematics allows for differing views of the same problem to be offered, assisting the development of positive attitudes to the subject (Siemon, 1983). Research as outlined by Haigh *et al.* (1995) shows that the integration of mathematics increases children's motivation, develops positive attitudes and increases student achievement. Denyer (1984) notes that mathematical integration also assists children to solve problems which occur in other areas of the curriculum.

Haigh *et al.* (1995) notes that the integration of mathematics is gaining in interest. The integration of science and mathematics is considered as a means of providing continuity between school and the wider community.

2.2.4 Use of Technology in Mathematics

Cuoco *et al.* (1995) noted that the increasing use of technology within mathematics classes is changing the very nature of the problems within mathematics and the way in which they are solved. Indeed, Bright *et al.* (1995) sees the use of technology as developing a new means of instruction, not simply the delivery of the same instruction through different media.

Kaput *et al.* (1994) identifies elements within electronic technology that enable change in the mathematics curriculum:

- Interactivity, for example, as seen within Computer Assisted Instruction;
- Control, which is the control over the learning environment which is of considerable influence on children's mathematical experience;
- Connectivity, that is, the ability of new technology to link children with children, children with teachers, teachers with teachers and possibly the world of education with the world of home and the community.

Jiang *et al.* (1995) notes the use of computers may change the content of the curriculum. For example, in countries where the use of computers in the classroom has expanded, more discrete forms of mathematics is being taught. As this has changed the aims of mathematics to some extent, as discussed by Cockcroft (1982), it does not in any way reduce the mathematical understanding required by the children. The aim of effective use of such technology within classrooms leads to the need, as identified by Alexander (1983), to increase the opportunities for in-service programmes for the teachers who use this technology in the classroom.

2.2.5 Attitudes Towards Mathematics

As stated by Philippou *et al.* (1995) and McLeod (1994), both the elements of children's attitude and motivation are major factors contributing towards successful learning of mathematics. Clearly, as identified by the NCTM (1989), methods used in teaching, such as discovery, problem solving and investigative work, all assist in developing positive attitudes towards the subject. It is from this basis that Howson *et al.* (1986) sees the importance of teaching a mathematics syllabus which is relevant and appropriate to the children's everyday life. D'Ambrosio (1995) also points out the value and use which could be used by teaching elements such as the history of mathematics.

The work of Ernest (1995) and Toumasis (1994) suggests that mathematics can be related to its social implications within society. This view suggests a fallibilist view of mathematics, whereas, if mathematics simply relates to a ready made abstract system this is expressed as an absolutist view. Humphreys (1983) points out the absolutist view is often expressed in mathematical textbooks, thus reinforcing in children the notion that mathematics is a subject with very little relationship to the other subjects on the curriculum or indeed, with the outside community.

2.3 TEACHING VARIABLES WITHIN SCHOOLS

2.3.1 Key Variables in Delivering the Mathematics Curriculum

Curriculum development, organisation and delivery, is a deliberate process of planned innovations. Therefore, there are many interacting factors which have a considerable effect on such a dynamic system. The aim of this section is to review the role of such factors which have influence on classroom practice, that is, the pupils, the textbooks, range of teaching methods used, methods of assessment, provision of adequate teaching resources and most importantly the teachers themselves.

2.3.2 The Pupils

When involved with any form of curriculum development the most important consideration must be the children's quality of life. The Curriculum Council for

Wales (1989) noted the school must attach the 'utmost importance' to the children's needs. Steinback *et al.* (1995) considers all concerned with curriculum development should consider the range of intellectual needs of the children along with such key factors of attitudes, expectations, motivation and, of course, their individual needs for development.

Throughout recent years within mathematics education, the issue of gender differences has been discussed considerably. Carrs (1983) views the gender problem as the difference in mathematical achievement between the two genders. Cockcroft (1982) notes there are no differences of achievement in the primary sector of education. However, in the secondary sector boys clearly outperform girls in mathematics with this trend then continuing throughout adulthood. Fennema *et al.* (1994) suggests these differences in levels of achievement are narrowing, though further studies are needed on this issue.

Fennema *et al.* (1995) notes a range of ideas offered to explain these deferences; for example, social factors and genetic factors are key suggestions. Steinback *et al.* (1995) considers the most serious of these suggestions to be attributable to society's expectations for boys to outperform females, thus perceiving mathematics as a male activity.

Dossey *et al.* (1988), as quoted by Steinback *et al.* (1995), show concern about the very negative outcome this perception may have on the attitudes and motivation of females towards mathematics. Foxman *et al.* (1989), considering the 1987 APU survey in mathematics, noted that it clearly showed more boys than girls considered mathematics to be important and useful to their futures. Howson *et al.* (1986) sees this lack of motivation to be derived from the belief that mathematics will be of less use within a girls career than a boys.

Miller (1995) relates factors within the school and classroom environment as of key importance to mathematical achievement, and such differences for boys and girls within the same community are likely to have considerable affect on their achievement in mathematics.

2.3.3 The Use of Mathematical Textbooks

Kapsalis *et al.* (1993) indicates that throughout the last decade it is common to see mathematics textbooks in classrooms accompanied by supplementary material. The purpose of such material is to provide support for the mathematics content to be taught within a programme. In some instances, the purpose may be extended to assist teachers in organising lessons, to assist with consolidation exercises and, as discussed by Chandler (1995), to review topics previously taught.

The quality of a textbook, suggests Kapsalis *et al.* (1993), is related to its content and methodological approaches suggested within it. Bell's (1978) view is that considerable importance should be attached to the presentation of the material within the book, along with support material accompanying the book. He outlines the following categories for evaluating mathematics textbooks:

- criteria relating to content and methods;
- criteria relating to physical characteristics and teacher aids.

Dorfler *et al.* (1986) points out textbooks are valuable to the extent to which they are effectively used. A common problem for teachers is an over reliance upon the textbook. It is essential, according to Kapsalis *et al.* (1993), for teachers to be informed of the correct way of using the textbooks, as determination of what is acceptable and unacceptable use could restrict creativity in the classroom.

2.3.4 Classroom practice

Work undertaken within the classroom critically determines the achieved curriculum. Cockcroft (1982) outlined essential elements for successful classroom practice, for example, variety in teaching methods and the range of activities undertaken by the children. Some elements are considered indispensable for the successful teaching of mathematics to occur, that is, exposition by the teacher, discussions between the teacher, children and peer groups, practical experiences, periods of consolidation, problem solving, applying mathematics and investigational work. Blackhouse *et al.* (1992) stresses how influential the Cockcroft Report and the Curriculum and Evaluation Standards document has been in developing variety of teaching styles in mathematics lessons.

Consideration of teaching styles leads to evaluation of teaching styles within different teaching circumstances and within different situations. Expository methods are appropriate to impart factual knowledge and develop our cognitive skills. Within mathematics teaching the work of Keegan (1995) and Jiang *et al.* (1995) has shown expository methods appear to work well for three forms of objectives:

- abstract concepts which are too difficult for students to self discover;
- simple concepts which may be understood by mere exposure;
- ideas that need to be drilled into routine procedure.

Alternatively, discovery methods seem more suitable for developing such areas as procedural knowledge, high level cognition and aspects within the affective and psychomotor domains. Keegan (1995) notes successful use of discovery methods requires a skilled educator, one who not only knows the subject material, but one who also has a thorough understanding of educational psychology. Although discovery methods are very time consuming, within mathematics teaching they seem to be the most appropriate method to use unless the teachers skill or resources are too limited, or the ideas and concepts to be taught are too difficult for the learners to discover (*ibid*).

Support materials are also expected to use discovery and problem-solving approaches. Jiang *et al.* (1995) notes that the large number of drill and practice exercises found in some mathematics textbooks are considered responsible for children's low achievement in tasks involving conceptual knowledge.

Manon (1995) notes the importance of introducing a range of assessment procedures which replace the written tests which have been extensively used over the past years. Cucoco (1995) and Apple (1992) advocate multiple sources of assessment procedures, for example, observations, communication and practical forms of assessment. Romberg (1992) indicates that as the emphasis on mathematics teaching is changing, for example from the drill and practice work on basic operational skills, to investigational work which teaches children to think, reason and solve set tasks, so must the criteria for judging achievement within mathematics change to align with these new procedures.

2.3.5 The Mathematics Teacher

The most valuable resource within education is teachers, with their ability ultimately determining the outcome of the education system. Fontana (1985) notes that as a result of teachers influence within classrooms, they are probably the single most important influence to bear upon children. Vergnaud (1995) notes the role of the teacher becomes especially important where changes in the curriculum are attempted, as teachers act as mediators between the curriculum and the children. This clearly supports the idea that teachers are critically important within the role of curriculum development (Hall, 1990). Teachers may be involved in curriculum development in two ways:

- as participants in the process;
- as users of the product.

Howson *et al.* (1981) states the nature of involvement varies within country to country. However, it mainly varies between countries as a result of differences in expectations of teachers and of their defined roles and responsibilities within different countries. In Britain, where the curriculum is process-orientated, teachers take on the role of the creator. However, according to Moore (1991), this traditional autonomy has been challenged by the introduction of the National Curriculum (see Chapter 3).

Stow *et al.* (1988) outlines the benefits of involving teachers in the curriculum development process, that is:

- the knowledge, expertise and experience held by teachers would be used for the benefit of the school;
- involving teachers in such development is more likely to contribute to the more effective implementation of the policy.

2.4 TEACHING METHODS

2.4.1 Using Concrete Material

Over many years investigations have directed attention to the important part played by concrete material in the learning of mathematics. This has been especially true in primary education where Burt (1937) states:

> *Since the child is so limited in his capacity for understanding abstract notions and grasping facts at second-hand through words, the teacher will have to present every new idea, so far as possible, in the concrete. Any efforts at getting the child to appreciate abstract formulae and generalised rules, in the hope that he may apply them spontaneously on the right occasion, will generally be doomed to failure.*

Indeed, Kephart (1971) writes:

> *Through these first motor explorations the child begins to first find out about himself, then the world around him, and his motor experimentation and his motor learning become the foundation stone upon which such knowledge is built.*

Beard (1963) outlined the important role concrete materials play in developing mathematical thinking in pupils during the primary phase of cognitive development. She suggests that a child who lacks experience of concrete aids will not adequately perform mental operations, so cannot develop the abstractions which are involved in more advanced mathematics and problem solving aspects the subject demands.

The use of activity methods was considered in the Schools Council (1972) publication: Curriculum Bulletin No.1. These practical activities are useful in the development of mathematical representation. Experiences, for example, with the matching or measuring of shapes, are of value mathematically, as the child in addition to looking closely, intuitively strives to maintain the correct relationships. The DES (1978), pointed out:

> *There was need to ensure that practical activities were suitably challenging and involved the use of numbers and other aspects of mathematics.*

Further, the DES (1989) when evaluating practical work in primary schools, noted the work took many different forms. However, three broad categories were clearly identified:

- those activities, such as measuring, which were aimed at delivering everyday practical skills and used as a means of providing the data required to solve problems;

- the use of structured apparatus designed, for example, to model the number system or to assist in the development of logical thought through carefully constructed collections of objects with a limited number of clearly defined attributes.

- those activities which provided physical realisation of a theoretical question or problem.

When considering these points, clearly there are many aspects to the term 'effectiveness'. From this analysis it may be concluded that the following are key generic contributors towards the effective teaching and learning of mathematics:

- practical, real situation approaches;
- clear, careful planning and preparation of material;
- use of effective techniques and programmes of delivery.

2.4.2 Practical Activity Approaches

Schonell (1937) suggested that continual practical work is an essential element within the primary school stage for pupils to develop mathematical understanding, and to use mechanical operations effectively. Cockcroft (1982) commented that 'practical work is fundamental to the development of mathematics at the primary stage'.

For some teachers the use of practical activities in primary classrooms, may be considered a relatively innovative step. However, work of this nature was proposed and implemented many years ago, for example, the Board of Education (1937), proposed:

> *First, by way of introduction, should come practical and oral work designed to give meaning to, and create interest in, the new arithmetical conception - through deriving it from the child's own experience- and give him confidence in dealing with it by first establishing in his mind correct options of the numerical and quantitative relations involved in the operation.*

The importance of apparatus in the learning process of mathematics was stressed by Piaget (1970) who stated:

> *The experimental method is not taught in any school and is a way of checking your hypotheses. If we can teach this method to children they will learn that it is possible to check their thoughts... If you spend one year studying something verbal that requires two years of active study then you have actually lost a year. If we were willing to lose a bit more time and let the children be active, let them use trial and error on different things, then the time we seem to have lost we may have actually gained. Children may develop a general method that they can use in other subjects.*

As a result of the Nuffield Mathematics Project, The Schools Council Curriculum Bulletin No.1 (1965) gave considerable support for the inclusion of practical activities within the primary school mathematics curriculum. Sampson (1975) proposed effective mathematics teaching needs the provision of practical activity experiences to 'establish operational adequacy and understanding'. Practical approaches are said to:

- assist consideration of real situations found within mathematics, to be undertaken by the children;
- allow the children to work systematically at their own pace;
- promote competence and ensure ease of learning;
- reduce the amount of incorrect work, and assist in the detection of incorrect method quickly.

The results of the testing carried out by the Assessment Performance Unit (APU), (1980) clearly illustrates the importance of practical work in children's mathematical development. Practical work is fundamental to the development of mathematical learning and its abstract application to problem-solving.

The APU (1980) noted there was:

> *clearly the need to provide opportunities for practical experience and experiment for pupils of all ages.*

2.4.3 Planning Approaches

Careful considerate planning within all aspects of primary education is essential for effective curriculum delivery. Gautard (1964) underlined the importance of planning for effective mathematical learning. He wrote:

> *There are moments of great wealth, when the projects have taken shape, the ideas are pooled, the various points of view examined, the suggestions and remarks taken into consideration and the problems assume a deeper perspective when individual realisation and collective proposals are received at the conscious level, measured against the original intention and recognised as total successes or partial failures. Alternating between periods of individual and collective work can thus become a powerful pedagogical technique.*

Cook (1948) suggested that for effective educational planning to meet the needs of pupils, three questions need consideration:

- Is the teacher flexible in meeting the needs of the pupils?
- Does the teacher plan for optimum development of individual pupils?
- Is the curriculum broad enough to recognise and reward the great variety of aptitudes and interests of the pupils in order that they discover their individual strengths and weaknesses?

Friebel (1968) considered that mathematics programmes for primary school pupils:

- are considerably improved in rich environments;
- should use concrete materials in real experiences;
- must be independent of reading and other academic subjects;
- must use and develop discovery and exploration methods within the activities undertaken;
- must use mathematical application to problem-solving activities.

Taylor (1970b), stressed adequate planning for effective mathematics teaching:

> *Planning a course of study for pupils and constructing the curriculum they will follow is central to the whole educational process. Upon this planning hinges a very great deal. It defines, directs, and co-ordinates what the pupils intended to learn, gives direction and purpose to teaching, provides it with justification, and gives it order and coherence.*

Tyler (1971), when considering planning, asked fundamental questions concerning aims, subject matter, organisation and evaluation:

- What purpose should the task seek to achieve?
- What experiences can be provided to achieve these purposes?
- How can these experiences be organised?
- How can teachers determine if these purposes are being achieved?

2.4.4 Techniques and Programmes

It was Greathouse (1966) who described a meaningful approach to mathematics teaching as one with a particular interest in mathematical understanding, in addition to one which develops computational skills. That is, an emphasis on greater understanding and use of mathematics in contrast to rote learning of arithmetical number facts. Using a meaningful approach involves the broad consistent use of teaching practices relating to the needs of individuals, in contrast to those techniques used for the needs of the whole class. This method demands both the identification and sympathetic consideration of individual needs within a group or class situation. Schacht (1967) suggested mathematical teaching programmes for pupils should include:

- greater emphasis on concrete, real material as opposed to the abstract, theoretical kind;
- the use of individualised programmes adapted to suit specific pupils needs;
- the provision of remedial reading instruction;
- provision of opportunities which relate mathematical learning to practical, real, problem solving situations;
- progress made at a slow pace, with ample opportunities for consolidation of tasks.

In a study based upon conditions of mathematics learning, Biggs (1967) suggested that approaches which use structural material increase competence. Multi-model methods encouraged are:

> *Specifically designed to provide a variety of possible immediate or perceptual coding so that a general conceptual coding may be constructed that unites the specific coding. When a variety of concrete material is used it is thought to be less likely that the child will rely in a rote fashion on any one particular method or set of rules.*

Dienes (1960) suggested that graded work cards are necessary for effective teaching, in order to:

- allow pupils to discover concepts;
- make learning a constructive activity through real experiences;
- lead pupils from concept to concept;
- help children build up the conceptual structure of mathematics.

Williams (1970) suggested that instructional programmes must depend upon:

- pupils' being at the readiness stage;
- a variety of approaches used to develop quantitative and notional concepts.

Otto *et al.* (1973) suggested effective techniques in arithmetic could be seen and considered on three distinct levels, that is, survey, specific and intensive. Considering these levels further:

- *Survey Level*: At this level examination of individual scores will not only show the fallaciousness.... but will also reveal other important points.
- *Specific level*: Teacher made tests are likely to be extremely useful for they can be used to pin point a particular area of difficulty.
- *Intensive level*: Teaching based upon specific diagnosis proves to be ineffectual, it will be a move to the intensive level of diagnosis to seek underlying causes for the learning problem.

Riding (1977) suggested the following conditions are necessary for the development of successful teaching programmes:

- teaching objectives are required;
- a varied range of teaching methods should be employed;
- pupils require assessment to determine their actual stage of readiness for learning.

The flow of feedback between each stage is required for the teacher to adapt and adjust the teaching method and subject content delivered to suit individual needs within each stage.

2.4.5 General Approaches

Doll (1964) stated that when teaching pupils mathematics a variety of techniques have to be employed to capture, develop and sustain pupils interest:

> *Learning is personal, unique, unstandardized. Furthermore, learning has numerous dimensions, and it is without limit. Obviously, then new and different proposals are needed.*

A study conducted by Meadow (1965) compared two methods of using programmed learning. The first, the individual method, secondly the teacher textbook method. From the results it was found that the use of programmed learning, with supplementals on an individual basis as required, proved more effective than the teacher textbook method in arithmetical achievement, also superior attitudes towards the subject were fostered and developed.

There has also been an investigation of relative effectiveness of three methods by Greathouse (1966). This involved group, individual and drill computation teaching. After investigating these techniques Greathouse concluded:

> *Pupils taught by the individual-oriented meaningful method achieved greater residual criterion gain than pupils taught by other methods.*

Fisher (1967) investigated three treatment programmes namely, individually prescribed instruction, programmed learning instruction and standard classroom instruction. The major outcome of the study resulted in the descriptive information of the differences between the three curriculum treatments. It was discovered participants in the innovative programmes appeared to have done as well as the standard classroom pupils, thus he concluded:

> *Pupils involved in programmes of individualised instruction can do as well on tests not specifically suited to programs with non-graded characteristics.*

Hilbert (1968) suggested that the solving of problems are necessary for successful mathematics teaching:

> *The great significance of specific problems for the advancement of mathematics in general, and the substantial role that such problems play in the work of the individual mathematician are undeniable. As long as a branch of science has an abundance of problems, it is full of life, the lack of problems indicates atrophy or the cessation of independent development. As with every human enterprise, so mathematical research needs problems. Through the solution of problems, the ability of the researcher is strengthened. He finds new methods and new points of view; he discovers wider and clearer horizons.*

Wedell (1970) described the approach of 'sequential strategy'. He suggested certain fundamental test information was needed in all cases. Further diagnostic techniques could then be used to explore the situation as and when need arose. Otto *et al.* (1973), outlined two aspects of remedial techniques:

- *Formal*: by using standardised tests, pupils' weaknesses and strengths can be assessed and determined.
- *Informal*: that is:
    - *i.* *Analysing the work undertaken by the pupils.*
    - *ii.* *Asking the pupils to explain aloud the method they used in solving a given task.*

Studies based upon considered successful mathematics programmes appear to favour the individualising of mathematics teaching for pupils at primary school level, currently within Key Stage 2. Riedesel and Burns (1973) concluded that individualised programmes of instruction led the pupils to higher levels of achievement in comparison with non-individualised programmes.

Lipson (1976) contributed towards development of an individualised programme for primary school mathematics teaching, emphasising that pupils' difficulties could be diagnosed. Also the programme gave pupils a dimension of freedom, independence and responsibility. Pupils within this environment had opportunity to ask questions about their work and it ensured each pupil worked to the limits of their knowledge with further development and improvement occurring from this basis.

2.4.6 An outline of Mathematical Teaching Strategies

Having considered a variety of approaches available to enhance the delivery of the mathematics curriculum, another important factor is the choice of teaching strategies to be used within the mathematics lesson. Brissenden (1980) noted:

> *Recent conferences on mathematical education show clearly that there is no comprehensive theory of teaching and learning mathematics which can be used as a guide to classroom practice; only partial, and at times competing, explanations are available to us.*

There appears not to be one overall strategy that is superior to any other. The processes of mathematics teaching and learning are far too complex for this. Rather, a range of strategies must be considered and applied to the varying range of situations and stages of maturity found within classes. However, strategies can be clearly identified that are associated with the effective teaching methods and learning processes of mathematics.

Results from Coleman (1963), Bloom (1964), Bruner (1966), and Roa (1967), offer support for this. They suggest the idea that effective teaching and learning is associated with:

- clear methods established for tackling a problem;
- assisting the learner to think for himself, that is, helping with concept formation;
- the learner continually developing and growing in self confidence;
- developing a positive learning attitude towards mathematics by the learner.

Fehr (1963) clearly advocated that teaching should implement these strategies when delivering the mathematics curriculum, having adapted tasks to meet the stage of learning readiness and past experiences of the pupil. Brissenden (1980) considered a number of strategies for developing mathematics teaching which he identifies as:

- the episode questioning style;
- the expository style;
- the problem solving style.

Brissenden (1980) characterised the 'expository style' as explanation combined with invitation-type question. The 'episode questioning style' uses minimum information-giving at the beginning of a lesson. Usually, questions from the teacher relate to, and arise from, aspects discovered by working through a problem. The 'problem-solving style' differs from the previous two mentioned. It offers the learner ample opportunity to reason out, and discover the steps involved in a solution. Brissenden (1980) further reasons that there is a clear expectation that the learner will undertake much of the work involved, including the development of personal ideas, when participating in the problem style.

Research identifies pupil involvement as one of the 'enabling conditions' for school improvement (Hopkins *et al.*, 1996; Stoll and Fink, 1996; Ruddock, Chaplin and Wallace, 1996). When considering the teaching of mathematics, discussion means considerably more than simple responses from pupils to questions asked by the teacher. It concerns itself more with the avenues explored, or issues raised from answers given to mathematical problems undertaken by the pupils.

Recently, as the content of the mathematics syllabus has grown, more and more areas of discussion have become available for teachers to develop and explore with their pupils, a wide variety of topics and aspect of mathematics. All children learning mathematics need this form of help and assistance, generated from mathematical discussion to establish and reflect upon the inter-relationships between particular topics.

There has been considerable attention focused within previous investigations on the issue of 'discussion' versus 'lecture' strategies. Ausbel (1968) indicated that where investigations had been undertaken, they showed little difference between the two teaching strategies in relation to children's mathematical achievement. McLeish (1968) noted that the lecture teaching strategy devoted almost all the available time to the presentation of factual information from the teacher to the pupil. This method assumes that all participants in this exercise are approximately of the same ability and are able to assimilate the knowledge given to them as a group. McLeish (1968) noted that during the lecture strategy of teaching, pupils may be sitting close to each other. However, any form of interaction between them is reduced to a minimum.

Clearly, mathematical discussion within the classroom is valuable to all processes of teaching and learning. Discussion leads to new ideas being generated and further developed, it furthers the opportunities for mathematical ideas and expectations to be consolidated.

2.4.7 Investigational and Problem-solving Work

The teaching of mathematics by 'investigational work' is very similar in nature, particularly in primary schools to the 'project' method of teaching. The strategy and process of investigation relates directly to the understanding of mathematical concepts, and the ways in which mathematics can be used to develop knowledge based upon everyday situations. Dean (1982) points out that worthwhile investigations should encompass directed, exploratory and free discoveries, as well as experimentation. This work relates closely to concepts developed by Piaget (1971), where at the primary stage considerably more meaningful learning occurs by doing, investigating and participating in a task. Cockcroft (1982), clearly notes:

> *The essential requirement is that pupils should be encouraged to think in this way and that the teacher takes the opportunities which are presented by members of the class.*

Mathematics is vitally important to society generally. One of its many functions is its application to specific situations or difficulties. It is the method of applying mathematics to these situations that is termed 'problem solving'.

Problem solving gets to the heart of mathematics. However, to solve problems adequately requires considerable practice and mathematical development. Therefore, at every stage of the teaching process, teachers should be aware of the need for pupils to seek to apply and develop the necessary skills.

Lamb *et al.* (1993) views problem-solving not as a distinct, absolute area or topic, but rather as a set of skills and concepts that must be acquired. NCTM (1989, 1983, 1990) notes this includes work based upon verbal representations of situations, geometrically, graphically, numerically and symbolically. These situations, as described by Natsoulas (1995), must encourage children to explore and determine a solution. In general terms, Fletcher (1983) and Cockcroft (1982) identified this aspect as the application of mathematics to every-day situations within the pupils experience, also within the realms of unfamiliar situations.

Bell (1978) views mathematical problem-solving as the resolution of a situation in mathematics that is considered as a problem. Broadly, this definition relates to the work of the NCTM (1989), when considering the aspects of 'doing mathematics'. Bell indicates that problem-solving within mathematics helps children improve their analytic powers, along with improving motivation and positive attitudes towards the subject. The importance of problem-solving activities within the mathematics classroom cannot be over estimated, as research findings clearly indicate the processes, concepts and strategies developed and used in these situations are transferable to situations outside of mathematics.

Dean (1982) notes that expository methods use lecture, inductive and deductive approaches to problem solving aspects of mathematics. The lecture method involves defining terms, expressions or symbols and, having explained these, finally summarising the components which have been broken down. The inductive method considers specific examples, identifies common properties and formulates a generalisation, whilst the deductive approach states a specific problem and then proceeds through a logical sequence of steps which lead to a conclusion. He offers four reasons why the exposition strategy of teaching has remained popular:

> *Firstly, they are mathematically neat and complete as each lesson contains a presentation and explanation of mathematics which lead to a conclusion. Secondly, they boost the teacher's self esteem as he is the font of knowledge. Thirdly, a teacher can get satisfaction from presenting a complete syllabus in a sequence of lessons. Finally, the teacher himself has often successfully learnt school mathematics in this way and expects his pupils to do likewise.*

So important has this strategy been within schools that Cockcroft (1982) cites "exposition by the teacher" as a fundamental ingredient of work in the classroom.

2.4.8 Mastery Learning

A major focus of debate on mathematical teaching strategy centred upon Bloom (1971), which was based on Caroll's (1963) model of learning. This model considered the following points necessary for mastery learning to occur:

- the subject is broken down into a series of short learning units;
- the teaching objectives, for example, knowledge comprehension and application, are clearly outlined for each unit;
- the learning tasks for each unit are delivered;
- formative, diagnostic tests are given at the end of each unit;
- the results of such tests are used to identify strengths and weaknesses of pupils;

- remedial procedures are developed for those not successful in the unit;
- upon completion of all course units a summative test is given to determine course results;
- the results of both formative and summative tests are used to develop and improve methods, materials and sequencing of teaching.

Gronlund (1974) modified this approach somewhat, and stated,

> *Bloom's Mastery Learning Strategy is a group-based approach that combines individualisation with regular classroom instruction. Individual Prescribed Instruction (IPI), is a highly structured individualised program of study that emphasises fixed objectives and systematic procedures for achieving them.*

Block (1971) also developed procedures from Bloom's taxonomy, which intended to develop effective learning strategies suggesting pupils' should:

- be graded on the summative test only;
- be graded on criterion referenced scales not normative scales;
- having reached a required standard, be allocated the appropriate grade;
- be given formative tests which would aid the pace of learning;
- be given help which matched individual needs and stages of development.

Within this phase of learning, in addition to the cognitive development, it is crucial that affective development is fostered and nurtured, that is, attitudes, interests, appreciation and adjustment in mathematics as a subject.

It has been shown that a variety of teaching strategies are available when delivering mathematics education within the classroom, each with equally its own merits and distinguishing characteristics. Of key importance is the fact that teachers should not only be aware of these different strategies, but be flexible enough in their teaching approach to change strategies when circumstances demand.

CHAPTER 3

ACHIEVEMENT WITHIN EDUCATION

3.1 ACHIEVEMENT WITHIN EDUCATION

3.1.1 Introduction

This chapter reviews literature relating to the present research problem, focusing upon 'achievement'. A range of variables are considered and their relationship with achievement is explored. These include intelligence, interest, motivation, socio-economic status, family status and attitude, i.e., those factors considered to have direct impact upon children's 'achievement' within school. These issues are discussed in the context of school effectiveness, and the need to enable children to develop to their fullest potential

Since the late nineteenth century various research studies have identified factors that contribute towards children's achievement and which underlie academic success. Some have analysed school based factors, while others have examined the balance between school-based and out of school factors. It is universally accepted that fulfilling the potential of each individual child is one of the principle objectives within education and must be central to all attempts at raising standards within any educational system.

Generically, selections of these studies are reviewed to evaluate their contribution to the understanding and causes of problems associated with under-achievement. The aim is to establish a sound basis for the specific investigations undertaken in later chapters which are based upon children's achievement in Key Stage 2 mathematics. The review covers the major studies and research results involving family, school and teacher variables.

Whilst acknowledging not all avenues outlined in the initial sections of literature review are pursued to the same depth, their inclusion within these chapters is considered essential for developing a wholistic and balanced perspective of factors that contribute to children's success within school.

3.1.2 Educational Achievement

By considering past research on educational achievement, it is clear that defining the nature of achievement is extremely difficult and not without controversy. One such definition given by Eysenck *et al.* (1975), stating achievement is:

> *1) A general term for the successful attainment of some goal requiring a certain effort, 2) the degree of success obtained in a task, e.g. solving a test, 3) the result of a certain intellectual or physical activity defined according to individual and or objective (organisational) prerequisites, e.g. proficiency.*

A more familiar and simpler definition of educational achievement at institutional level may be:

> *an assessment centring on the relative performance of particular schools or other educational institutions, as well as that of different groups in society.*
>
> (Varma & Ashworth, 1986).

At an individual pupil's level, its meaning does not vary greatly as the emphasis and concern is always focused on the individual's performance.

Failure to fulfil potential, or what may be termed as under-achievement, may be regarded as the dysfunctioning of pupils within schools, and can be seen as the difference between their predicted and actual performance. An initial definition of academic underachievement is offered by Kornrich (1965), who stated:

> *a definition of academic underachievement is a simple matter. After all, intuitively, does not the term directly suggest that a student (pupil) is functioning less well than he or she could? But what is the meaning of 'less well' and 'could'? Is it less well in terms of a standard established by the student ('I think I could do better'); by the student's parents ('We know he could do better'); by the student's teacher ('He has more ability than he shows') or by an objective intelligence or aptitude test which predicts a certain level of performance?*

These issues are repeatedly considered in research material focusing upon underachievement.

Recognition that academic under-achievement may cause serious social and psychological problems was reflected upon by Raph *et al.* (1966), who stated:

> *The values of a culture which attempts to look beyond performance to potential; maintains a prolonged compulsory system of education; seeks to nurture and develop diversity of abilities within and among individuals; and concerns itself with maximum development of the individual as well as his contribution to society.*

These aspects appear to be the very basis of previous research which focuses upon the problems of the unfulfilled potential, posing the question, "why (or how) did this happen?"

MacGilchrist, Myers and Reed (1997), argue that there are three essential elements within an effective school, which:

> *create the right conditions to enable them to develop into very effective institutions in terms of their pupils progress and outcomes.'*

These elements are:

- a concentration on teaching and learning;
- high quality leadership and management;
- a learning organisation.

A major element of this research will be to look beyond these elements and examine the perceptions and attitudes of teaching staff as they relate to any effect the introduction of the National Curriculum has had upon realising the potential of all children.

Many researchers define underachievement in terms of 'unfulfilled potential'. For example, Durr (1964) defines the gifted underachiever as one who achieves below his potential, where potential is defined in terms of I.Q. and achievement in terms of teacher grades or achievement tests. Similarly, Gold (1965) perceives the underachiever as one who does not fulfil himself, i.e., whose achievement falls more than one standard deviation below the point which might be expected on the basis of I.Q. It is unclear if measure of achievement here is based on school grades and if so, it does not consider the problem of teacher bias involved in the process of awarding school grades.

A further definition of underachievement is that of Bricklin & Bricklin (1967), who state:

> *If a child is not accomplishing at a level commensurate with his intellectual ability, he is an underachiever.*

In attempting to assess the contribution of some definitions to making a better understanding of the term 'academic underachievement', one is faced with the difficulty of the central terms used in definitions, that is, 'the potential of the underachiever', which cannot be easily defined. Raph *et al.* (1966), stated:

> *Only if it were possible to assess potential with sufficient accuracy to enable prediction of performance for all individuals would such a definition become operationally meaningful.*

As a result of such difficulties, some researchers have attempted to develop operational definitions of underachievement. For example, Shaw (1964), defines a child as an underachiever:

> *If he is in the upper 25% of his class with regard to intellectual ability and falls below the class average with respect to grades.*

Therefore, one might agree with Zilli (1971), who concluded for research purposes, one must arrive at an acceptable operational definition of academic underachievement in order to determine which factors in the underachiever's personality and environment contribute to his failure to fulfil his potential. This notion is absolutely critical when determining, if academic standards are in decline.

Gowan *et al.* (1972) suggest that problems arriving at a clear definition may in itself account for failing to develop solutions to the problem of underachievement. Burt (1975) has drawn attention to the magnitude of what he considers to be 'human wastage'. Based upon the analysis of the distribution of ability and scholarships in different social classes in London, Burt (1975), concluded:

> *Findings imply a wastage of nearly half the available talent latent in the non-professional classes.*

Although these findings were based upon data obtained from a London survey conducted by the National Institute of Psychology (1956) and a survey of social structure in England and Wales completed in 1937, Burt (1975), maintains that the problem of unfulfilled potential is of a serious and prevailing nature. Further, failure to identify and develop ability in young children may account for the scope of this problem.

Clearly, educational achievement, also sometimes described as school attainment, is the outcome of learning as a result of a teaching process which is measurable by some form of test. The statement of achievement or result may refer to a specific subject or to the whole range of subjects followed.

Research into factors determining school achievement is extensive. The very existence of differences in school achievement has been the topic of many government reports, particularly in the industrialised countries. Despite the amount of research undertaken, there continues to be considerable disagreement about the influence of schooling on children's development. Clearly, as identified by Myers (1995), schools make a considerable difference at varying rates. Additionally, Reynolds and Cuttance (1992) note:

> *Schools do not act alone; children belong to families and to communities. As they move along the improvement journey, schools appear more confident and increasingly pro-active in developing meaningful and close informal or semi-informal relationships with parents, the community and local schools.*

Careful examination of studies shows that when like is compared with like the results of the different investigations are very much in agreement on the main findings. The divergence in evidence largely arises when studies have gathered different forms of data, or have used different statistical analysis to answer quite different questions about differing educational situations.

To conclude this section, an analysis of literature concerned with factors that could relate to the problem of academic underachievement suggests that three aspects may be considered as contributory and require further research and evaluation. Briefly, these are:

- attitudinal factors;
- curriculum organisation and teaching methods;
- teacher and pupil variables, including gender, educational achievement and attitudes.

These factors will be returned to throughout this dissertation.

3.2 FACTORS INFLUENCING EDUCATIONAL ACHIEVEMENT – VARIABLES OUTSIDE THE SCHOOL

3.2.1 Internal and External Factors

Educational achievement is not, and cannot, be understood in terms of any one single factor. Achievement is an outcome of a wide variety of many different, interacting factors, which may generally be classified under two headings: internal and external factors. By internal factors is meant the individual's abilities and general make up, that is, intelligence, motivation, personality and attitude etc. External factors relate to the environmental conditions that the individual is exposed to, that is, school, home, community, peer group etc.

It should be understood that the internal and external factors are to be perceived as dynamically interacting and creating an entity, not as single items, compartmentalised and isolated. However some researchers argue certain factors are more influential in determining academic achievement than others. For example, Walberg *et al.* (1986), suggest:

> *Academic achievement is a function of five proximal factors - student age, ability, motivation, the amount and quality of instruction, and four supportive or substitute factors. These being the environment of the classroom, home, peer-group outside the school, and mass media, particularly television, to which students are exposed.*

This point is crucially important and must be understood, for this study will focus upon a number of factors which are considered by the researcher to affect achievement in schools. Thus a very broad and panoramic viewpoint is taken, enabling a balanced perspective to be gained. Internal factors have a considerable effect on achievement, as noted by Rutter and Madge (1977):

> *Educational failure is a frequent, but not universal concomitant of low intelligence.*

It may be assumed that all those inner factors are essential, but not individually in themselves, sufficient to produce success at school. Research has shown that school achievement, with success within school depends on many aspects. For example, social status, background, environment, family circumstances, parental practices, family size, order of birth in family, peer group, school characteristics are likely on different occasions to have an influence on a child's level of achievement within school.

Education partnership between the home and school must be considered to be of key importance. However, one needs to be aware of negative attitudes. For example, Stern (1997) notes of some teachers attitudes that:

> *families cannot be in a partnership with schools (and certainly not an equal partnership), as schools are filled with experts, whilst families are not.*

Unfavourable social background conditions can lead, in many situations, to underachievement or lack of success in school. Fuller and Stevenson (1983), reported on the Community Development Projects, which aimed to aid poor areas in Britain (launched in 1963), and noted:

> *The inner areas of most of our cities are characterised by severe housing problems, labour markets that offer less pay and intermittent employment, poor educational attainment, high rates of crime and delinquency, and relatively heavy demands on health and social services.*

Studies have shown that social differences also affect language development and expression of ideas. For example, working class children are less explicit in the use of language than middle class children. Consider Bernstein's (1971), work on language development, it is claimed that working class children have a restricted code or style of language whilst middle class children tend to have a more elaborate one. Considering this theory, it is possible to understand the work of Conger and Peterson (1984), who noted that disadvantaged children:

> *Tend to depend more on real life encounters than on symbolic experience in developing ideas and skills.*

Possibly this helps to explain why disadvantaged children perform poorly on conceptual thinking and cognitive tasks, and why their scores improve on motor tasks based upon concrete objects and situations. Such factors are likely to have major effects upon children's achievement within the Standard Assessment Tests, introduced within the overall framework of the National Curriculum. However, such a set of circumstances does not always lead to low achievement in school. Indeed, Mortimore and Blackstone (1982), noted that within their group of disadvantaged children one in seven did have better results in mathematics and reading scores than half the non-disadvantaged children.

Clearly, with the time and resources available for this study not all these variables will be covered within this research however it is intended to focus upon many of the issues developing from these areas, to establish a balanced opinion of key elements which affects educational achievement within the primary sector of education, particularly in terms of achievement in Key Stage 2 mathematics as a result of the implementation of the National Curriculum (1988).

3.2.2 Personality

Many forms and variations of definitions of personality are to be found, depending on the context under consideration. Personality as defined by Eysenck, Arnold and Meili (1975), is:

> *The relatively stable organisation of a person's motivational dispositions, arising from the interaction between biological drives and the social and physical environment. The term... usually refers chiefly to the effective-cognitive traits, sentiments, attitudes, complexes and unconscious mechanisms, interests and ideals, which determine men's characteristic or distinctive behaviour and thought.*

Fontana (1978) perceives personality as an all embracing term which refers to the whole make-up or total characteristics of an individual. For the purpose of this study this section will focus specifically upon Esynck's dimensions of personality, that is, extroversion -introversion and neuroticism-stability.

Several studies have shown that extroversion is highly linked with academic success, particularly at primary school level. However as children develop and go through school, introversion seems more related to achievement at higher education. Fontana (1978) suggests that the nature of the subject areas, or disciplines considered, are an important factor in determining whether extroversion-introversion is to be considered as a positive factor with regard to achievement. This is supported by the work of Entwistle (1987), Eysenck (1986) and others. Riding and Banner (1986), found that extroverts were better than introverts at language skills. However this result is not always true, as Riding and Cowley (1986), also introduced a factor of gender differences. They found that introverted girls achieved higher reading scores than extroverted girls. The issue of gender differences in relation to mathematical achievement at 11 years of age will be returned to at a later stage within the local study element of this dissertation (see Chapter 5).

Considering neuroticism-stability, research evidence suggests that anxiety is highly related to poor scholastic performance. Elliot (1972) supports the finding that anxiety tends to increase among poorer achievers. It is apparent that there is a positive correlation between anxiety and poor educational achievement, especially in the primary and secondary school, although this changes form when considering higher education. It was found that students with higher scores of neuroticism did perform better than those with lower scores on that characteristic in their examinations. However these findings are difficult to generalise as some evidence suggests that sometimes anxiety may be a good thing to possess. However, it should be noted that certain amounts of anxiety is always essential for successful achievement. As noted by Fontana (1978), the Yerkes-Dodson law stipulates:

> *A mild degree of anxiety may be a help in all subjects, since it improves motivation.*

Another key factor of personality which affects achievement within school, is outlined by Mevarech (1985), who defined temperament as:

> *A stylistic aspect of behaviour, with style referring to the how of behaviour as opposed to its content (the what), or motivation (the why).*

Many studies have been carried out in an attempt to determine the role of temperament and its affect on educational achievement. It clearly demonstrated that pupils who possess the qualities of low distractibility, high persistence and ability to adapt to new situations, are more likely to attain a high level of academic achievement. Mevarech (1985), found there is a strong relationship between a pupil's temperament and his or her level of achievement. He stated:

> *Of particular interest was the finding that for the second grade, temperament characteristics contributed to the prediction of mathematics achievement more than intellectual skills.*

However, it should be noted that this result is based upon a three week classroom observation of second and fourth grade pupils in one school.

Conger and Peterson (1984) found that underachievers have different personality characteristics to their successful peers. They are less positive, more impulsive and pleasure seeking, and have very little or no respect for authority. In addition to this, Conger and Peterson (1984) demonstrated that over-achievers also have specific characteristics, such as greater interest in school work, greater responsibility and a sense of planning. However, over-achievers have some 'negative' personality characteristics such as feelings of inadequacy, unworthiness, and excessive anxiety. Nevertheless, this does not minimise the positive role played by personality characteristics as investigated by Gage and Berliner (1979), who emphasised the need to achieve as a major contributing factor to schools achievement. Hart (1985) also outlined the importance of positive attitudes in terms of success, whilst Purkey (1968) identified a positive correlation between self-esteem and levels of school achievement.

To conclude this section on personality, it should be noted that a well-balanced personality is a significant aid in promoting achievement within school. This factor will be returned to within the national element of the empirical study (Chapters 6 and 7).

3.2.3 Family Status

A range of research studies have been undertaken outlining the comparative role of the family with regard to the education of their children. Indices usually measured are social class, family size, the families level of education, home stability, parents aspirations for their children, parents job, and socio-economic status (SES). In addition material possessions owned by the family, income of parents and occupational prestige have all been found to significantly affect children's achievement within school.

Cambell's (1951) study of secondary school pupils identified the importance of home environment on the success of children's scholastic work. It also concluded that the cultural characteristics of the family have an influence on pupil's achievement in school. Within the United States, Shuey (1956) claimed that scholastic achievement of children was dependent upon family factors including the level of education of parents and the number of siblings within the family unit. Fraser (1959) demonstrated that the cultural, motivating, economic and material factors within a family have an influence on the general academic achievement of the child in school. In Britain, the research of Douglas (1964) showed that parental interest in their children's school work, plays a significant role in the academic performance of pupils in school.

Alternatively, French (1959) and Ross (1969) investigated school achievement within Britain and drew very different conclusions. They revealed that occupation or the level of education of the father has only a slight relationship with achievement scores of their children within schools.

Kemp (1954) and Coster (1959) investigated whether academic achievement was more dependent upon pupils' economic status than other factors which they considered to influence success in school. They both concluded that children's academic achievement is more dependent upon ability than upon socio-economic factors of the home environment. In addition, Delaney (1971) and Chan (1974) also conclude that achievement is more related to ability than socio-economic status. However, they also concluded that socio-economic status was a significant factor in developing the child's perceptions of their school activities. Nicholas (1964), attempted to classify children on academic merit and a variety of socio-economic factors. He concluded that successful children varied greatly from the average pupils irrespective of socio-economic status or the home environment.

Whitemand and Deutsch (1968), reported a significant correlation between a socio-economic index and achievement in a reading test in twelve schools in New York. Coleman (1966) reported a correlation of sixth graders' test scores and their father's occupation for the verbal test and somewhat lower scores for reading, mathematics and non-verbal ability. Anderson (1967) reported the zero-order correlation between father's occupation and the mathematical achievement of thirteen-year olds participating in the investigation of the International association for the Evaluation of Educational Achievement (IEA) as: Australia 0.22, Belgium 0.24, England 0.38, Japan 0.25, Netherlands 0.33, Scotland 0.27 and Sweden 0.20.

Jencks (1972) postulated that the most important factor in educational achievement was family background. This factor related to a number of different aspects, for example, measurable in economic terms and the more difficult aspect of parental behaviour and stability. In an extensive review of the SES achievement relationships Jencks (1972) concluded:

> *Taking the evidence together, we estimate that the family's socio-economic status probably correlates about 0.35 with the children's test scores.*

Re-analyses of the Coleman data have confirmed the original findings. Smith's (1972) re-analyses showed that a very large amount of school to school variation in achievement was attributable to differences in home background. The Plowden Report (1967), which drew on similar evidence to the Coleman Study (1966), also concluded that home influence far outweighed those of the school.

Very early research indicated a clear association between socio-economic status and educational achievement. Burt (1943) reported a low positive correlation between children's intelligence and economic status. Lindsay (1926) wrote when considering scholarships at 11-plus:

> *It has been conclusively proved that success in winning scholarships varies with almost monotonous regularity according to the quality of the social and economic environment.*

It seems the consistent relationship between father's occupation and school achievement has been frequently summarised at every level within the educational system. However mother's occupation before marriage has also been included in a few studies. There seems to be some evidence that this factor does operate as an independent variable, particularly in influencing working class success. Floud, Halsey and Martin (1957) showed that those mother's whose occupation before marriage was superior to that of their husbands were more likely than other mothers to have children who were successful in the 11-plus examination.

The level of parental education is also a useful index of socio-economic status and is used in conjunction with income and occupation for this purpose. Clearly, a direct link exists between the intellectual level of their parents, their educational aspirations for their children and the 'educability' of the home. This may take form in practical ways such as, helping with homework, the interest shown in children's work and in enforcing greater pressure for educational success.

Parental attitudes to education are also an important variable. Floud, Halsey and Martin (1957) found a positive correlation between these and success in the 11-plus examinations, while Peaker (1967), having measured performance on a standardised test of reading comprehension in a large-scale study of British elementary schools, reported that parental attitudes accounted for more of the variation in children's achievement than material circumstances in the home or in schools.

Pidgeon (1959), when reviewing the work of the National Foundation for Educational Research, stated:

> *The most important factor bearing on the educational progress of all those so far investigated, was the attitude of the child's parents.*

Fraser (1959) investigated whether environmental factors were related to achievements as a result of the factor of intelligence. School test marks were scaled against IQ scores and used as a criterion of educational achievement. A comparison was made between the correlation of each environmental factor with the criterion and its correlation with IQ. Fraser (1959) noted:

> *Since most, if not all, of the home items are closely related to intelligence, and since the Criterion itself is very highly correlated with IQ, it follows that any item, if it is to add at all to intelligence as a predictor of school success, should correlate more closely with the Criterion than with IQ. The greater the difference between the correlation's, the more important is the home item from the point of view of school attainment.*

Assessment of home environment was considered in terms of three aspects: economic and material, emotional and motivating. Of ten items which made up the assessment of home environment, three correlated highly with school achievement, namely attitude, income and living space.

There is also evidence that suggests that low achievement in school of some working-class children is affected by their poor economic position. Poverty may exert its influence on school achievement in a number of indirect ways. For example, Sexton (1961) demonstrated that children from poor homes are affected by higher rates of sickness and thus poor rates of attendance follow. In addition to home factors, researchers have also focused attention upon neighbourhood factors which may affect standards of achievement. Naturally, different districts, regions and neighbourhoods are not culturally, or economically developed to the same measure. Some researchers are of the opinion that educational achievement may vary according to the region of the country in which children live. Burt (1950) undertook a preliminary survey in London to discover the geographical distribution of educational backwardness. According to Burt's calculations, backward children were to be found in the poorest districts of the East End and similar areas. He concluded, poverty, emotional and moral problems, low intellectual conditions of the home all contributed to the educational weaknesses of the children, as displayed at school through their levels of achievement. Byrne (1972) argued that differing conditions within neighbourhoods certainly contribute to different levels of pupil achievement in school, also, there are other factors other than a child's ability which may predict differences in achievement and these factors may be obscured by theoretical stances taken by some educational psychologists.

Many suggest the family background of an individual is more important than the persons genetic inheritance (Mortimore and Blackstone, 1982). Family size has been associated with school achievement, where it is claimed that children from large families tend to achieve less than pupils from smaller families. This is supported by the work of Anastasi (1976) and Douglas (1964). Also children from large families according to Rutter and Madge (1981), tend to perform badly in national examinations and leave school earlier than their counterparts from small families. Poor achievement here is generally meant to mean results with verbal intelligence and reading tests.

It is noted that these findings only apply to low income families, as shown by Rutter and Madge (1981), that little effect of family size on middle class children's achievement has been reported. Thus Rutter and Madge (1981), argue it is not the size of the family that influences children's achievement but parental characteristics, they claim:

> *It seems probable that among those parents who produce very large families are a proportion who have not planned their families, who do not manage their affairs very well and who tend to live for the present.*

Concerning the birth order of children within the family, Douglas *et al.* (1964) found that eldest children performed better than younger ones. The differences noted however, were quite small. Parenthood is also of key importance when considering school achievement, Conger and Peterson (1984) indicate that parents of achieving children:

> *are likely to place a high value on autonomy and independence, and on mastery, competence and achievement generally; to be democratic and encouraging of an active give-and-take interaction with their children; and to exhibit curiosity and respect for knowledge.*

Studies have shown that the parents of achieving pupils show more interest and understanding and give their children more praise and approval. Generally, they make school an enjoyable and rewarding experience for their children. On this matter, Conger and Peterson (1984) concluded that:

> *The families of high achievers were significantly more likely to do things together, to share ideas, and to involve their children in family decision making. They were also more*

> *likely to display parental approval, confidence and trust, and less likely to engage in over restrictive controls and overly severe discipline. Overall morale in these families was far higher than in families of underachieving boys.*

Another key element in school achievement seems to be that of family disruption. It seems that adverse experiences, for example, maternal deprivation, broken homes, constant family aggression and hostility may interfere with intellectual development, thus lowering educational achievement. Rutter and Madge (1981) argues:

> *Mothers going to work, fathers being away from home and broken homes all come under suspicion.*

Family factors are clearly, quite critical in the understanding of children's achievement in school. Children raised in institutions appear to have poor academic results, which could mean that broken homes, or similar conditions lead to failure at school. This however, is not always the case, as reported by Rutter (1981), who analysed the findings of Vernon (1972) and concluded that bond disruption, through loss of parents, cannot be regarded as significantly affecting children's school work. Rather, attention should focus upon the family environment as a means of stimulus deprivation, which may lead to lower academic achievement, as according to Rutter (1981):

> *It seems that it is not whether you are brought up at home or in an institution which matters for cognitive growth, but rather the type of care you receive.*

Clearly all studies of disadvantaged children report wide and conflicting responses, however, as indicated by Rutter (1981):

> *Even with the most terrible homes and the most stressful experiences some individuals came through unscathed and seem to have a stable healthy personality development.*

The research studies reviewed appear to offer a range of different opinions and results, and provide no conclusive evidence to suggest that family status, economic or related factors affect the performance of pupils' school work in any one particular way. Clearly the achievement of children in school is dependent upon many factors. Consequently it cannot be concluded that pupils' achievement is dependent only on socio-economic status and any privileges attached to it within society. Therefore any findings in this area must be considered with care, especially when attempting to make sweeping generalisations as a result of them. Consequently factors discussed within this section on family status will not be pursued directly within the present study. However, elements will be taken up when considering the effect the introduction the National Curriculum has had upon school/community relationships and the children's affective domain.

3.2.4 Intelligence

The term 'intelligence' is used in this study to refer specifically to scores based upon tests of intelligence quotient (IQ). There are a number of reasons for choosing this definition. First, because intelligence itself is an abstract notion and cannot be dealt with directly. Second, too much past research based upon intelligence generally, seems to have generated fruitless debates. Third, despite its acknowledged limitations the IQ test as described by Rutter & Madge (1981), continues to be the most reliable and valid indicator of potential achievement. More recently Eysenck (1986) supported this notion stating:

> *Clearly there is a powerful biological determinant behind intelligent behaviour, as measured by psychometric tests.*

Intellectual capacity, has often been considered by educators as being directly related to output of all aspects of academic work. Erickson (1958), for example, when reporting an investigation of the relationship between intelligence and mathematical achievement of pupils in the USA, reported there was a significant relationship of correlation between intelligence quotient scores and mathematical performance. Balow (1964), researching arithmetic, reading and intelligence as measured by computational ability, discovered when intelligence was monitored there was evidence of a significant difference. This was found to be associated with reading ability, the higher the reading ability, the higher the scores found in problem solving activities. Burt (1977) published results of inherited intelligence and pupils capacity to learn mathematics, given the correct form of teaching.

Other studies reported by Marjoribanks (1977) support association between the notion of intelligence and ability:

> *In general, the mathematics performance of the 11 year olds had strong associations with intellectual ability.*

Alternatively, it may be claimed that pupils with low IQ scores experience considerably greater difficulty in achieving success in academic activities. Examples supporting this may be seen in the work of Sumner & Warburton (1972) who reported:

> *The attainment of allergic pupils generally declines as time goes on, presumably because the pupils get more and more reluctant to exert themselves for the kinds of objectives set by schools.*

Whilst intelligence quotients may be a reasonable indicator of potential ability, it must be noted that IQ is not always associated with educational achievement. Many children who are considered to be bright and able, do fail to achieve what is expected of them. They may be considered as low achievers in the sense that their achievement appears to be below their potential aptitude.

This outcome is not so unusual, when considering IQ and achievement, for studies have shown that any form or level of educational achievement is not the result of any single factor. Indeed, Crooker (1987) pointed out:

> *Good evidence that concepts of general intelligence are not good enough when considering performance in school subjects, with particularly low correlation's between the scores of children of high language ability compared with physics and mathematics and vice versa.*

Clearly 'intellectual potential', as outlined by IQ tests, should be used cautiously as a means of predicting academic achievement. Realistically IQ tests should be considered in terms described by Le Francois' (1979):

> *The score (IQ) can be used to predict how well a student should do, and can therefore help the teacher arrive at some reasonable expectations for that student.*

This is currently the case with many schools using IQ tests as a major method of measuring what is termed 'intelligence' and relating it to pupils' potential achievement. This follows Rutter and Madge's (1981) rationale who concluded that:

> *Many studies have confirmed that well established IQ tests do indeed this, that is, to assess how children are likely to respond to particular types of schooling and to predict their scholastic achievement - with reasonable accuracy both within the normal range and with respect to mentally retarded persons.*

However, Bloom (1971), having studied this factor in relation to mathematical achievement, placed considerably more emphasis on the results of interactions between the learner and the learning environment, rather than a product of fixed individual differences such as intelligence. From the substantial findings of previous research studies it can be concluded that intelligence may be a predictive factor in recognising mathematical ability. Consequently the use of I.Q. measurement will not be pursued within the context of this study.

3.2.5 Motivation

A motivated child is one who is urged and driven, through some sense of purpose, to achieve. Mussen (1983) defines motivation as:

> *The contemporaneous factors that incite and direct behaviour, that influence the direction, the vigour and the persistence of an action.*

Motivation in children, or more precisely the need for them to achieve, is a learned quality, which increases their work effort, in an attempt to out perform others. Shaffer (1985) offers two reasons for such a trait:

> *1) To satisfy their own needs for competence or mastery, or*
> *2) to earn extra incentives or approval.*

Clearly, a pupil's performance in any subject, is likely to depend on the level of motivation of the pupil towards that subject. Richardson, Eysenck and Piper (1987) state:

> *There is a strong feeling that motivational factors are crucial whenever a person achieves anything of significance as a result of learning and thought, and I cannot think of exceptions to this statement.*

One crucial remark to consider when focusing on motivation is given by Vernon (1972) who argues that "Strong motivation cannot compensate for low intelligence." It obviously helps an individual child to use his abilities to the fullest; however motivation will not make up for a lack of ability.

Bloom (1976) investigated the qualities of a number of outstanding young Americans in a variety of different disciplines, such as arts, sports etc. It was revealed that all these achievers were highly motivated individuals, in addition it was noted:

> *The sheer extent to which, in at least some stages of a person's development, motivational influences appear to have been more important than other crucial factors, such as technical expertise on the part of instructors.*

Entwistle and Kozeki (1985) identified a strong link between school achievement and motivation. They also developed a specific theory that argues that a child's achievement can be explained through the interaction between nine motives which constitute three different and separate domains. The first, called affective, relates to parents, teachers, peers and comprises of three motives, they are warmth, sociability and identification. The second is cognitive and links directly with competence, interest and demand for independence. The third is moral and links directly with trust, compliance and responsibility and is seen to be the outcome of interaction between affective and cognitive domains (see Figure 3.1).

	DOMAINS		
	Affective	**Cognitive**	**Moral**
	Warmth (Parents)	Independence	Trust
MOTIVES	Identification (Teachers)	Competence	Compliance
	Sociability (Peers)	Interest	Responsibility

Figure 3.1: Factors of School Achievement

(*From British Journal Of Educational Psychology, 55, 2, p.124*)

Entwistle and Kozeki (1985) established that certain motives are more related than others towards achievement and competence, while some motives are more associated with girls than with boys.

A key motivating factor appears to be based around the notion of rewards. Learning theories have attempted to establish that if an individual is to undertake a given task, that individual has to be rewarded for the accomplishment of the task. This is clearly understood, however, it must be made aware to teachers and parents alike, that more attention must be made to the different domains of reward available, that is, the affective, the moral, the cognitive and the social aspects of giving rewards.

Rewards need also to be given in an 'appropriate way', that is, to be used at the right moment and in the right place. An example of inappropriate reward is cited by Entwistle (1987) who wrote:

> *The teacher finished by asking the children to write an exciting story about fruit we eat. In fact the children wrote very little. They took great pains to copy the date from the board. They formed their letters with great care and used rubbers copiously to correct any slips in presentation. Whilst this went on the teacher moved around the class commending 'neat work' and 'tidy work' and chiding 'dirty fingers' and 'messy work'. No further mention was made of 'exciting' content of stories.*

Clearly, motivation is critical to success and achievement in school. A child may have all the qualities that are needed for success, yet still doesn't fulfil his potential. A possible explanation for this is that the child simply is not motivated to do so, or that he is not motivated at all. Factors relating to children's affective domain will be returned to in this study.

3.3 FACTORS INFLUENCING EDUCATIONAL ACHIEVEMENT WITHIN THE SCHOOL

3.3.1 School and Teacher Variables

There is a considerable amount of research evidence suggesting that teacher variables have an affect on the academic achievement of children. A range of studies have examined the administrative and organisational aspects of schools. That is, the availability and effects of school resources such as physical facilities, science and mathematics laboratories, reference materials, teacher qualifications and experience, teacher gender and motivation and so on. Other studies have focused upon policy controlled variables and are based upon the use and development of textbooks, time spent in schooling, numbers in class, effects of homework, student-teacher ratio, per pupil expenditure, classroom methodology, and curriculum etc.

For some time research studies have indicated that generally schools make very little difference to pupil achievement. This view seems to originate from Coleman's (1966), report on 'Equality of Educational Opportunity' and Jenck's *et al* (1972), 'Inequality: A Reassessment of the Effect of Family and Schooling in America'. Coleman conducted a large-scale survey and concluded that educational achievement was largely independent of the schooling a child received, while Jencks re-assessed a mass of statistical data from three school surveys and concluded:

> *Additional school expenditures are unlikely to increase achievement, and redistributing resources will not reduce test score inequality. The gains associated with any given resource are almost always small....no measurable school resource or policy shows a consistent relationship to schools' effectiveness in boosting student achievement. The specific school resources that have a 'statistically significant' relationship to achievement, change from one survey to the next, from one method of analyses to another, from one type of student to another.*

These results seem to suggest the effect of school based resources on academic achievement is pupil-specific rather than general. This is supported by the work of Jensen (1969), who reviewed evidence of factors which influence IQ and school performance, drawing his highly controversial conclusion that "Compensatory education has been tried and has apparently failed."

The Plowden Report (1967) drew on data similar to that of the Coleman Study and concluded that the influence of the home environment far outweighed those of the school. This view is supported by the work of Goodman (1959), Molenkopf and Melville (1956), and Peaker (1967). Thomas (1962) and Kiesling (1969) found that per-pupil expenditure, teacher qualifications and experience, and class size all relate to student achievement in reading scores and information tests. That is, pupils achievement scores are either pupil specific or subject specific related. However, Summers and Wolfe (1975), when studying pupil school achievement found that:

> *For many school resources, the effect on some types of students is very different... and frequently in the opposite direction from the effect on other types of student.*

They state:

> *The reason educational studies have failed to find that the things schools do are effective, is that there are few things which are consistently effective for all students.*

Much research focuses upon assessing school factors relating to achievement which the schools themselves seek, namely, achievement in which the curriculum is adequately reflected. This has mainly taken the form of measuring cognitive development, as assessed by standardised tests of achievement. This is clearly seen through the work of Coleman *et al.* (1966), with its re-analyses by Mayeske *et al.* (1973), and Smith (1972).

Most importantly, Jencks (1972) drew attention to the fact that school achievement as measured by Coleman et al (1966), measured only one dimension of achievement. It was clearly shown that it was the verbal ability nature of the tests that defined the variability used to represent differences in achievement.

Studies of measurement of cognitive achievement based upon school examinations are those of Brimer et al (1978), Carnoy-Thias (1974), Haron (1977), and Madaus et al (1970). Of these Brimer (1978), stated:

> *Certainly, so far as the central point of this question is concerned (whether schools contribute to differences in achievement) almost all between-school variance is explained and schools do indeed share a much larger contribution to the explanation of variance than previous studies.*

More recently, research such as that undertaken by Fuller (1986), Hanushek (1981), Purkey and Smith (1983), and Rutter (1983), investigate the effects of many material ingredients and social practices found within schools, where especially in the schools of Britain and America, according to Barr and Dreeben (1983) effects of social organisation and teaching methods appear to be stronger.

To conclude, the role of schooling variables on levels of pupils' achievement seem to be more important in developing countries and more so for marginal and deprived groups. However, according to the work of Alexander and Simons (1975) the average rate of learning of primary and early secondary children is not markedly affected by educational policy changes along traditional lines, such as providing more, or better facilities.

Finally, when considering the effects of schooling on children at this stage of curriculum development, the remarks of Mortimore and Blackstone (1982) must be remembered:

> *The extent to which school characteristics affect pupils' school achievement is in need of more research.*

This aspect will be returned to within the context of this study.

3.3.2 Gender

There is considerable interest in issues of gender with reference to academic achievement. Emphasis placed on female pupils' achievement in relation to their male counterparts, especially in the specific subject areas of mathematics and science, continues to grow.

A brief review of previous studies offers conflicting evidence and opinions on issues of gender. For example, Kelley, (1967), reported boys did perform better than girls in science. The following reasons were offered to explain this:

- males seemed to be more concerned with the task, no matter how wrong or right they may be, unlike females;
- boys participated more in classroom discussion and activities, possibly because they are motivated to do so. Females tended not to participate and appeared to be annoyed if found to be wrong;
- teachers tended to pay more attention to boys than girls, encouraging boys to engage in discussion and activities, whereas, girls did not receive the same amount of attention;

- boys tended to be more mentally prepared intellectually, in terms of preferences to tackle and deal with scientific subjects;
- male pupils appear to be more positive and hold more favourable attitudes towards scientific subjects than girls.

Similarly, Grant and Harding (1987), noted from a study based in the Netherlands that has been used in pilot studies in ten other countries, that:

- girls were less interested in technology than boys;
- girls were perceived by boys (but not by girls) to be less able in technology than boys;
- girls tended to have a less broad definition of technology than boys;
- girls did not perceive technology to be as important as boys did;
- girls were less acquainted with technology than boys.

Developing these arguments, it would appear girls performed less well than boys in scientific areas as a result of attitudinal causes that hinder achievement. This suggests that it may be possible to suppress gender differences with respect to educational achievement in scientific subjects by changing or varying certain values that make these subjects less attractive for girls. Some attempts at making these changes have been made. However, it seems that no conclusive results have been established.

Parker and Offer (1987) noted that:

> *Equal course taking is a necessary but not a sufficient condition for equal achievement.*

However, they insist that intervention programmes and awareness of relevant issues are also essential for improvement. Where intervention programmes have taken place, for example in Norway, improvements have been made. However, (Verne, 1987) notes: "The effect seems small compared with the effort put in."

In terms of attitude towards mathematics, Dutton (1956) noted evidence in his study suggesting that girls dislike arithmetic more than boys. However, this difference was insignificant. This outcome is further supported by the results of Shapiro (1961), Keane (1969) and Aiken (1972), who stressed there was no significant difference between the means of the mathematics attitude scores of boys and girls in the eighth grade.

A number of studies have, however, revealed that boys differ considerably from girls in their attitudes and interests towards mathematics. Cockcroft (1982) focused upon a number of studies when reviewing gender and mathematical achievement, noting that:

> *Among the objections to mathematics as an important subject for girls were that the subject was uninteresting to most girls, that its utilitarian value to them were negligible, which could explain the lack of interest, and that its difficulty put a strain on pupils out of all proportion to the benefit received.*

The Assessment of Performance Unit (APU) (1980) found some differences between the performance of girls and boys in certain areas of the mathematics curriculum, in the results of written tests at the age of eleven:

> *The girls' mean score is significantly higher statistically in computation (whole numbers and decimals). The boys mean score is significantly higher statistically in three sub-categories: length, area, volume and capacity; applications of number; and rate and ratio.*

Cockcroft further reported that analysis of performance in the London Board O-Level Syllabus C papers (1973 and 1974) revealed that on the whole:

> *None of the items on which girls out-performed boys required what could be termed problem-solving behaviour; instead they call for recognition or classification, supplying of definitions, application of techniques, substitution of numbers into an algebraic expression and so forth, just the kind of operations which are most susceptible to drilling.*

Fennema and Carpenter (1981) made an analysis of the mathematics test of the USA National Assessment of Educational Progress (NAEP), in which testing was undertaken for pupils at ages 9, 13 and 17. The results were analysed on the basis of knowledge, skills, understanding and applications. The findings revealed that, with the exception of the skills scores of pupils aged 9 and 12, boys out performed the girls in all cases. Also the higher the cognitive level, the greater the difference between the genders. It was also noted that in items relating to geometry, including measurement skills, geometric manipulation and items relating to perimeter, area and volume, the differences were particularly large. These findings confirmed the results obtained by the International Study of Achievement in Mathematics (Husen, 1967), which had compared achievement of boys and girls at the age of 13.

Lerner and Lerner (1977) also compared gender and academic achievement. Their results showed that gender had no effect on pupil's academic achievement. However the small number of pupils studied made any generalisation inconclusive.

Johnson and Murphy (1986) conducted a study on the influence of gender on children's performance in 'concept application' in science, at ages 11, 13, and 15 years. Although with varying degrees of correlation, boys appeared to achieve slightly higher results in all aspects of the science application tests. This finding supports to some extent the view of Harnisch, Steinkamp, Lingtasi and Walberg (1986), who indicated that gender differences in both attitudes and achievement were small.

From the review undertaken, it is possible that a marginal difference does exist between the sexes in terms of mathematical achievement. As attitudes towards the subject play an important part and with boys tending to like mathematics more than girls, it is likely that boys will do better when both sexes are given equal opportunity to learn mathematics. However, considerably more research is needed in this area before such generalisations can be made.

The issue of gender in relation to mathematical achievement of eleven year olds will be returned to within this study.

3.3.3 Attitudes

Oppenheim (1966) wrote that:

> *Most definitions seem to agree that an attitude is a state of readiness, a tendency to act or react in a certain manner when confronted with certain stimuli.*

Johnson (1967) maintained that attitudes were the very basis of behaviour and ultimately they determine not only the pupil's willingness to study and learn, but also determines the pupils' further use and application of the subject. Aiken (1970) noted that:

> *The relationship between attitudes and performance is certainly the consequence of a reciprocal influence in that attitudes affect achievement and achievement in turn affects attitude.*

This observation is further supported by Lum (1960) who stated underachievers were easily discouraged when faced with difficult tasks that required sustained efforts to complete. Of significance here is the observations of Terman and Oden (1947) who noted that the successful group, as opposed to the unsuccessful one, displayed considerably more task commitment.

Frankel (1960) found that underachievers expressed negative feelings towards school, showed less interest in school work and displayed inefficient methods of maximising learning. Also, underachievers had more discipline troubles and significantly higher absenteeism rates. Similarly, Wilson & Morrow (1962) noted underachievers had more negative attitudes toward school and teachers, also having lower aspirations for obtaining good marks in relation to their achieving peers.

Such behaviour patterns possibly develop early in a child's schooling as a result of unchallenging learning activities, lack of stimulation, or repeated failure in school work. Douglas (1964) found that the attitude of children to their school work was considerably affected by the degree and scope of encouragement their parents gave them. Jordan (1941), Arvidson (1956), Wall *et al.* (1963), Shinn (1956) and others, have reported similar studies in which pupils' attitudes have been found to be significantly related to academic success.

Farcely (1976) found a positive correlation between attitude and achievement in mathematics. It was noted that the higher the attitude score, the greater the gain on the test requiring a high cognitive level, the lower the attitude score, the lower the gain on test.

The findings of studies relating to school attitudes and study habits of underachievers, indicate generally that underachievers hold negative attitudes towards school and school orientated activities. Also they have disorganised study habits. It seems reasonable to hypothesise that school attitudes, study habits and academic performance are to some extent interrelated. It seems relevant to investigate these factors within the school situation which are conducive to forming the kinds of attitudes which have negative or positive influences on the child's motivation for learning.

It appears worthwhile to question if attitudinal factors alone, from outside and within school, can take responsibility for academic achievement. Moreover, it seems reasonable to hypothesise that negative school attitudes may have resulted from the failure of the school to stimulate the child by providing relevant and adequate learning experiences and appropriate teaching methods. In addition, research undertaken by Whipkey (1970), and Keane (1969), suggest not only the attitudes of pupils, but also the attitudes of teachers were related to achievement levels of their pupils in mathematics tests.

Husen (1967) in a similar study noted a substantial coefficient of correlation between attitude and achievement. However, Neale (1969), stated that attitude toward mathematics plays a limited role in achievement. Rather, he claimed it was achievement that cause favourable attitude. From the substantial amount of research material and evidence of correlation between achievement and attitude in mathematics, it seems that a positive attitude towards mathematics has direct influence on the level of achievement of pupils in mathematics. However, the full extent of the relationship is unclear and requires further investigation.

3.3.4 Teaching Theory

Consideration of content and curriculum organisation leads to consideration of specific methods which may be used to deliver the curriculum. Rowntree (1982) outlines two generic categories from which teachers may select their teaching methodology, that is, expository and discovery methods. The expository teaching approach instructs and imparts to the children all the information they need to know, whilst the discovery methods imply that the students are led to find out for themselves. Research findings in learning theory and applications of these within the classroom, enable teachers to select a teaching method according to the nature of the planned work.

The work of behaviourist and associationist psychology, Gestallt psychology and cognitive psychology have been very influential upon classroom practice. Within mathematics, the developmental work of Swiss psychologist Jean Piaget (1896-1980) also influenced curriculum practice especially within primary education. Recent learning theories such as information processing theory and constructivist theory have also influenced classroom practice. These theories will be discussed in the remainder of this section.

Piaget's genetic epistemology is a study of children's developmental stages in terms of acquisition of knowledge. Piaget states the mental development of children is made up of three successive stages each of which 'enhances and develops the previous stage, reconstructs cognition on a different level and surpasses the earlier stage'. These stages are:

1. The sensorimotor stage (birth to 18 months); during this stage the child lacks symbolic ability, therefore attention must be on reality.
2. The symbolic stage or prcconcrete-operational stage (18 months to 7/8 years of age). This is the stage where children develop ability to represent things in symbols.
3. The concrete-operational stage (8 years to 12 years); this is the period where children learn to think and work in the abstract.

At the age of 12 to 15, children are entering the stage of formal operations where the ability to state hypotheses is developed. Children are then able to develop ideas and evaluate their thoughts. Piaget's cognitive approach is mainly appealing to the primary stage of education because of its relationship to the early levels of the development of intelligence.

Behaviourist learning theories focus upon behaviour which is observable. Therefore learning methods for behaviourists focus upon a stimulus-response pattern. In this context, stimulus is defined as excitement placed upon the learner by the environment, whilst response is a reaction made by the learner to the stimulus. Thus the principle of the learning process is organised around the relationships between stimulus and response. Therefore teachers who use these methods need to select the desired changes in behaviour that are to be displayed by the children and then organise the appropriate stimulus-response patterns to achieve the desired change. These changes in behaviour are of course the learning objectives associated with the curriculum.

Probably, the most influential of behaviourist theories to enter the classroom environment is Skinner's operant conditioning. Its principle involved dividing learning objectives into a large number of smaller objectives, which can be worked upon one by one, that is, the introduction of task analysis within education. As noted by Romiszowski (1981), Skinner's operant conditioning theory made a significant contribution to teaching methodologies in such educational areas as programmed learning and computer assisted instruction. Its key importance lies in the fact that it established the foundation for the development of instruction theories which are open to test and verification procedures.

Many behaviourist theories have been rooted in more difficult learning theories or approaches. For example, the eclectic psychomotor approach of Robert Gagne. Romiszowski (1981) differs from the strict behaviourist in two ways. First, it is accepted that a range of different methods of learning which are appropriate in different situations of learning may be applied. Second, it is accepted to some extent that the processes of motivation, creativity etc., have some impact upon the learning process. Gagne and Briggs (1974) describe eight distinctive classes of learning, with the corresponding sets of conditions that are associated as:

1. Signal learning, where the child learns that an event is the signal for another event and thereafter responds appropriately to the signal, for example, moving away from a source of heat.

2. Stimulus-response learning, where the child learns a specific response to a discriminated stimulus, for example, developing speech.

3. Chaining, where the child acquires a chain of related stimulus-response associations, for example, learning to tie up a neck tie.

4. Verbal chaining, where the child's process of chaining consists of verbal associations, for example, repeating the multiplication tables.

5. Discrimination learning, where the child is able to respond differently to similar stimuli, for example, giving appropriate answers for a set of open ended problems.

6. Concept learning, where the child learns a common response to an entire range of stimuli despite differences in appearance, for example, developing the concept of classification.

7. Rule learning, where the child is able to merge concepts into a relationship.

8. Problem-solving, where the child is able to merge previously acquired rules to develop a new, higher order rule.

Gagne and Briggs (1974) noted that most forms of teaching within schools are based upon level 6 to 8. The key argument of this concept is based upon the idea that learning occurs through a form of hierarchical backward thinking. Gagne proposes that each learning objective be split up into smaller objectives known as enabling objectives. These enabling objectives represent the requirements that the child should possess at this level of the planned learning programme.

Developmental cognitive theories of learning are closely related to the work of Bruner (1966). His psychological theory is eclectic in nature, based upon theory drawn from the disciplines of biology, philosophy, anthropology, sociology and linguistics. Bruner's work on 'structure of the disciplines' is directly based upon the work of Piaget. Bigge (1982) points out Bruner's central principle is structure, that is learning is 'connecting things that are akin and connecting them into structures that give them significance'. Therefore, structure would be the very essence of understanding. Bigge (1982) shows how learning according to Bruner involves three processes occurring simultaneously, that is:

- acquisition of new information;
- transformation of knowledge;
- evaluation of relevance of knowledge.

The general learning process therefore occurs in three modes, that is, the enactive, the iconic and the symbolic. The enactive stage is very manipulative where the child learns to handle and work with concrete objects. Throughout the iconic stage, children develop and work with mental images that stand for a concept, yet not yet fully defining it. In the symbolic stage the child is able to handle abstract ideas and work with symbolism. Clearly these modes of human development reflect the stages of development within Piagetian theory. However, they are in no way isolated in single stages preceded by leaps, as outlined by Piaget. Rather they are related to one another and extend intact throughout a persons life.

Bruner (1966) argues 'any idea or problem or body of knowledge can be presented in a form simple enough so that any particular learner can understand it in recognisable form'. The teaching implications of this means that it should be possible to represent, order and present information in a form that is appropriate to any child's mode of learning. Bruner (1966) calls these the problems of structure, sequence and embodiment.

Howson *et al.* (1981), when considering the teaching of mathematics, sees its understanding as a continuum. Therefore the teacher should find out what ideas and knowledge have been taught at an earlier stage, and then build upon them. Also to look to the future, and teach concepts and knowledge, even without mastery.

Dienes' (1960) theory of learning identifies six stages within the process of learning mathematics, that is:

> First stage, the free play stage where the child is introduced to an environment where help will be given to grasp mathematical ideas.
>
> Second stage, the rules of the game where the child is confronted with some restrictions in the playing environment, which are a set of rules relevant to the mathematical structures being taught.
>
> Third stage, where the child is shown how to extract from a set of structural games the underlying mathematical abstractions.
>
> Fourth stage, of representation where the child's not fully aware of the abstraction made, however a method of representation of the abstraction is required.
>
> Fifth stage, description of the representation is developed through the use of language. Through such work a system of axioms are being developed.
>
> Sixth stage, rules for proving the game where the child is taught how to reach any part of a mathematical structure, given a starting point. These methods of proving the game will eventually develop into the theorems of the system.

Greer (1989) indicates the dominant position in cognitive psychology is held by the information-processing learning model. This, according to Gagne and Briggs (1974), is considered to be a major advance in the scientific study of human learning, considering learning to be a process or more likely a set of processes. The principal idea is the learner receives stimulation from the environment which activates receptors in the learner to produce a patterns of neural impulses. Philippou *et al.* (1995) points out the information may then be stored in short-term memory where it is subject to rehearsal. It is also an input for the long-term memory provided it has been meaningfully encoded. By processes of search and retrieval the stored information may be returned to short-term memory. From this structure, or directly from long-term memory response generators generate suitable responses.

However, with regard to mathematics teaching, Greer (1989) argues that to think of mathematics in terms of information-processing only is much too narrow a view of mathematical thinking, and of mathematics as a human activity in a cultural context in general.

Noddings (1990) identifies the psychological outlook of constructivism on teaching and learning as both a cognitive position and a methodological perspective. As a cognitive position constructivism is a form of cognitivism developed as a result of Piaget. Smith (1993) identifies the basic assumption that all knowledge is constructed and that the instruments of construction include cognitive structures, either innate or constructed. Therefore Steffe *et al.* (1994) note that anything a child may see, hear and remember is the result of a cognitive mechanism through which learning is constructed.

The use of methodological constructivism in the teaching of mathematics suggests the learning of mathematics should focus upon understanding rather than drill and practice routines. Philippou *et al.* (1995) note appropriate teaching time should be devoted to children's active participation in the lesson; a spiral approach adapted in developing concepts, with the children's interests and motivations taken into account, with a range of media available to support learning.

3.3.5 School Effectiveness

Everard and Morris (1990) relate effectiveness to the quality of the completed task, which is the best achievable in the given time constraints, making full and economic use of resources. Tomlinson (1983) notes very limited research in the United Kingdom up to the 1980's had studied home and school variables affecting achievement. However school effectiveness research focus upon academic and social factors.

Most of the research undertaken in Britain has looked at secondary schools. Indeed, Reynolds (1989) wrote that there are only three British projects to systematically collate data on school effectiveness, two of which were undertaken on secondary schools. Mortimore *et al.* (1988) show there has been a remarkable lack of research on children under the age of 11 years of age. Tizard *et al.* (1988) wrote of the little research which existed considering relationships between children's achievement and the extent of the curriculum taught to them.

An effective school is described as 'one in which pupils progress further than might be expected from consideration of its intake' (Mortimore, 1991), and one which 'adds extra value to its students outcomes in comparison with other schools serving similar intakes' (Sammons, Hillman and Mortimore, 1995).

It is noted there has been considerable focus within Britain on what exactly are the role of schools and what priorities should they have. Clearly, differences between schools in terms of organisation and practices have little connection between the children themselves, rather, it relates to the training and development of the teaching staff and the motivation within their roles. Tizard (1988) points out there are considerable discrepancies in what is taught between children within the same class.

Reynolds (1989) shows there are limited findings within Britain on school effectiveness. Indeed, Mortimore *et al.* (1988) show only the London junior schools study focuses upon the primary phase of education. From this study Stoll and Fink (1989) consider the school may have a far larger effect on the variation of a pupil's progress than factors of background, gender or age.

Mortimore *et al.* (1988) noted the ILEA junior school study collated data based upon social class, gender, ability and race of the children upon entry to junior school. It was found that this form of detailed data is a poor predictor of progress without further data collation based upon the organisational character of the school to be evaluated within the same context.

It was found some schools were advantaged in terms of status, size, staff turnover, and environment, however, these factors in themselves did not amount to effective schools. The research showed voluntary schools seemed to be more effective as were small junior schools with a roll of 160 or less. Critically, this study showed that it was factors within the school, within the control of the Headteacher and teaching staff, which are crucial in the development of the children, that is, the mechanics of school organisation are crucial to children's achievement. Many publications list these characteristics (Stoll and Fink, 1996; Reynolds, Boller, Creemers, Hopkins, Stoll and Lagerweij, 1996).

Mortimore *et al.* (1988) offers 12 factors for junior school effectiveness:

1. Purposeful leadership of the staff by the Headteacher who clearly understands the needs of the school.

2. The involvement of the deputy Headteacher.

3. Teaching staff fully involved with the planning and development of the curriculum.

4. Consistency among teaching staff in delivering the curriculum.

5. Teaching sessions where children's tasks were well organised, with a range of tasks for completion.

6. Intellectually challenging teaching.

7. Work centred environments where ample time was devoted to pupil feedback on their tasks.

8. Limited curriculum focus with approximately two curriculum areas within one work session.

9. Maximum and effective communication between teacher and children.

10. Efficient record keeping with samples of children's work.

11. Parental involvement within the school.

12. A positive climate with less focus on punishment and control with a greater emphasis on praise and rewards.

A key element within the concept of developing school effectiveness is leadership within the school. Fuller (1992) subscribes to this view when he argues that leadership should be shared across the whole school. Indeed, Jenkins (1997) notes that the head-teacher and others in leadership roles adopt much more collaborative ways of working.

Yates (1992) develops the concept of schools effectively managing change and identifies the followingh features for a successful outcome:

1. A notion of a realistic and achievable aim.

2. Development of standards to foster standards, performance and quality.

3. A school development plan involving short and long term aims, financial planning, training and staff development plans, prioritisation of plans and a mechanism to measure achievement of aims.

4. Viewing change in terms of school development and pupils needs.

5. Encouraging teamwork within school.

6. Shared responsibility and collaboration.

7. The balance of leadership across the organisation.

8. High priority given to staff motivation.

9. Creating a climate of continuous learning, development and improvement.

Clearly, many schools whilst having achieved significant improvements or having made changes to effect school improvement, some schools had 'travelled further in the school improvement journey' (Hopkins, Ainscow and West, 1996). However, becoming more effective is a dynamic process. As MacGilchrist, Myers and Reed (1997) argue, 'schools are ever-changing, organic organisations.'

CHAPTER 4

RESEARCH METHODOLOGY

4.1 PURPOSE OF THE STUDY

4.1.1 Introduction

This chapter describes the research methods used in the study. There are two aspects to the study and for clarity, the methods are discussed separately. The first aspect of the work relates to a local study and is based upon research undertaken on pupils' performance in mathematics over a twelve-year period within a junior school in Wales (see Section 4.2). The second area of study involves a national survey which was undertaken using a representative sample of schools throughout Wales. This aspect of the work focuses directly upon the perceptions of head-teachers, deputy head-teachers and teachers in relation to the effects of the introduction of the National Curriculum within schools. In particular, the research approach adopted, along with the development of a questionnaire for eliciting respondents opinions on specific aspects of this study is described (see section 4.3). A rational of the theory, which supports the chosen methods, is provided, with examination of the reliability and validity of the methods used. The research questions are stated and a description of the target population and sampling frame is given. Possible limitations of the study in terms of experimental design are discussed as are the methods by which collated data is analysed.

The aims of this study are very much supported and directed by the literature available on the theory, practice, evaluation and research of mathematical achievement worldwide, within Britain and particularly within Wales. Essentially, this study investigates the mathematical achievement of children within Key Stage 2 of the National Curriculum framework in Wales, and the perceptions of teachers in relation to this important aspect of the primary curriculum.

4.1.2 Aims of the Study

This study is centred around the growing concern that there has been a lowering of academic standards generally and a fall in mathematical competency in particular. For example, the OFSTED Mathematics Review (1995), noted:

> *For some time, there has been general concern about the teaching of mathematics in primary schools... Inspection evidence from the academic year 1993-1994 supports this general concern. In Key Stage 2, mathematics is judged to be the weakest subject in the curriculum.*

Indeed, Prais (1996), when discussing deficiencies in mathematical achievement in Britain in comparison with other European countries, stated:

> *The deficiencies could be traced back to the primary phase of schooling, more particularly to the great variability of British pupils' attainments in upper primary school classes (the junior school or Key Stage 2).*

Since the National Curriculum was designed and introduced with the purpose and vision of raising standards of achievement, it must be appropriate at various stages to determine the success of those efforts. It follows, therefore, that a principle aim of this study is to assess and evaluate the current status of the National Curriculum, with respect to mathematics education within Key Stage 2. This study seeks to provide a perspective on this by ascertaining the views of teachers, deputy head-teachers and head-teachers. As well as collecting opinions on standards and pupil performance, information was sought in relation to the implementation patterns and practices of schools, and the skills and personal qualities of school staff who implement the National Curriculum.

Presently, within the British education system there is growing interest and increased pressure at all levels for greater accountability. In the current climate of improvement towards excellence, schools can no longer continue to do things just because they were done in the past. They must be prepared to justify that what is done is valuable and worthwhile. Thus schools must be able to provide documentation and evidence that is clear, meaningful and understandable to all concerned parties to show school programs are 'good value for money.' Schools within Key Stage 2 are no exception to this and consequently it is considered that the views of staff within these schools will provide a valuable perspective on the impact of the National Curriculum.

The effects the National Curriculum has had upon the teaching and learning of mathematics within primary schools are considered within two distinct sections of this study. The first part of this study provides a perspective at the local or micro level. Specifically, data based upon children's mathematics test scores and collected by the researcher from one junior school over a twelve year period (1983-1994), is considered and evaluated in order to identify trends in children's mathematical performance, and any effect the introduction of the National Curriculum may have had. The aim of this aspect of the work is to compare the mathematical achievement of successive cohorts of eleven year old children, at the end of Key Stage 2 of the National Curriculum framework, considering:

- whether evidence exists to substantiate the claim that mathematical competency is in decline;
- which specific areas of the mathematics curriculum pose greatest problems for children at this age;
- whether there are any significant differences in mathematical performance between boys and girls at this age;
- what effects the introduction of the National Curriculum may have on the mathematical attainment at eleven years of age.

The second part of the study considers the wider context and is based upon a survey of a representative sample of schools throughout Wales. The aim of this aspect of the study is to evaluate teachers' perceptions and opinions relating to changes introduced by the National Curriculum, and the perceived effects that these have had upon mathematical achievement of children at eleven years of age.

An evaluation such as this can help to improve the practices of staff within school. Evaluative information serves a summative purpose, that is to determine whether or not something works. It also serves an extremely important formative purpose of constantly checking what is working and where there are difficulties. As difficulties and problems are detected, intervention may be made so as not to build upon a major problem that could limit the effect of the whole program.

Currently, within Wales, the implementation of the National Curriculum is at the very heart of school improvement efforts and has major implications for the whole education system. Schools have invested a considerable amount of time, money, personal, physical resources and energy in implementing the National Curriculum framework. However, existing knowledge of what the actual effect this innovation has had upon schools is limited. Therefore, while examining the effects of introducing the National Curriculum, the final aim is to investigate the perceived impact on staff of the various aspects of school practices when implementing the program.

4.2 THE LOCAL STUDY

4.2.1 Research Design

The methodology used in the local study involves the statistical analysis of data collected over a twelve-year period, within one junior school in South East Wales. Initially it was planned to collate a range of data pertaining to children's mathematical achievement at eleven years of age, from a range of sources, thus enabling a comparison to be made of trends in children's mathematical achievement. However, having attempted to obtain such data from sources such as Local Education Authorities, The Welsh Office, The National Foundation for Educational Research, The Welsh Joint Education Committee and County Subject Advisors, it was disturbing to realise that no such generic data based upon children's mathematical achievement was available within Wales at that time. Consequently it was necessary to utilise data of a more localised nature. Such data was readily available to the researcher as a result of being employed within a junior school as a classroom teacher throughout the period September 1985 to July 1994. Data drawn from a total sample of size 766 children (377 boys and 389 girls) is considered in this study. This data is available from summative tests administered annually to 12 consecutive year groups (see Table 4.1).

Table 4.1 Year groups providing data for study

	Boys	Girls
1983	43	29
1984	27	30
1985	30	43
1986	32	32
1987	29	32
1988	43	38
1989	41	57
1990	59	48
1991	28	32
1992	15	14
1993	12	15
1994	18	19

This data is used to:

1. compare pupils' mathematical achievement throughout the twelve-year period, that is, throughout the years 1983 to 1994;

2. identify any significant differences that occur in mathematical performance between boys and girls throughout this period.

3. investigate pupils' mathematical performance in specific areas identified within the test instrument in order to determine which aspects of the mathematics curriculum provide the greatest difficulty for pupils at this age.

Although the data was readily available to the researcher a letter seeking permission to use it for research purposes was sent to the school's head-teacher (see Appendix 1). Permission to undertake such work was granted in March 1993 (see Appendix 2).

4.2.2 The Test Instrument

The instrument used for this aspect of the study is the written test paper Mathematics 10 (NFER, 1984) which had been designed to measure mathematical performance of children approaching the end of Key Stage 2. This standardised test had been used in the school from June 1983 and was constructed by the National Foundation for Educational Research, using language which had been simplified as much as possible in an attempt to test mathematical skills, concepts and recall of basic facts, rather than reading ability in the areas of mathematics, i.e., number, measure, shape & pictorial representation (see Table 4.2). It is designed for group administration with no time limit imposed. The paper contains 50 questions selected to assess a broad range of skills (see Appendix 3). The questions require pupils to demonstrate the ability to operate at a variety of different levels using a range of concepts and skills.

Table 4.2 Concepts and Skills Covered in the Test Instrument

	Understanding of basic concepts	**Computational Skills**	**Application of concepts and skills**	**Recall of basic facts**
Number	Place-value Commutativity Grouping Structure of number Equivalence of operations	Formal & informal addition, subtraction, multiplication, division	Solving problems involving number	Names of number sets with specific properties, e.g. odd numbers
Measures	Value of units of measure		Solving problems involving number	Names and equivalences of units of measure
Shape	Various properties of shape, e.g. symmetry			Names of shapes and lines within shapes
Pictorial Representation	Interpretation of a graph involving scale		Extraction of information from a graph	

There are four distinct sub-areas that may be identified within the test instrument. The purpose of this study is to work within these sub-areas as the basis for an analysis of pupil performance and achievement. It is recognised that other researchers may wish to categorise the test questions or items in a variety of other ways, however, within the context of and for the purposes of this study, items will be categorised within the sub-areas as discussed within this methodology. These can be related to the range of activities pupils participate in when being introduced to new mathematical ideas:

- initial experience, often of a practical nature, designed to develop understanding of the concept or process that is being introduced;
- extraction of any relevant computational skill or series of skills;
- application of skill in problem solving context;
- recall of facts or mathematical terms which are pertinent from new work and experiences

The questions included in the test instrument focused upon key issues of curriculum content along with the broad teaching objectives of primary and early secondary school mathematics teaching, that is, the understanding of basic concepts, developing computational skills, the application of concepts and skills, and the recall of basic facts. Some questions within the test instrument by the nature of their content may be allocated to either of the four skill/ concept groups outlined within the test instrument. However, this aspect of the study is comparative and summative in nature and not formative (see page 140) and the successful achievement of each question is based upon the entirety of the skills/concepts undertaken in obtaining the correct answer. Therefore analysis of responses within this study will focus solely upon the distribution of questions as indicated and classified within each of the skills/concepts categories prescribed in Table 4.3. Each of the items within the test instrument have been allocated to one of four areas according to the following broad teaching objectives:

Computational Skills: questions designed to test computational skill where the operation is explicit or relatively unambiguous. These questions are indicated by an oblong symbol.

Understanding of Basic Concepts: questions that require an understanding of basic concept(s) and/or the interpretation of mathematical language before they can be answered correctly, involving the interpretation and understanding of the process rather than in the performance of a numerical operation. These questions are indicated by a triangle shape. This category includes questions where the numerical operation is not explicit.

Application of Concepts and Skills: questions that test the ability to use a range of mathematical skills in a variety of everyday situations. In addition to requiring the interpretation of language, these questions demand the necessary combination of skills in order to solve the problem. This involves determining from the context the required operation. These questions are indicated by a diamond shape.

Recall of Basic Facts: questions which require no calculation and that can be regarded as testing basic knowledge, that is, the recall of one or more mathematical facts or terms. These questions are indicated by a circle shape.

The questions on the paper are distributed among the four sub-areas as indicated in Table 4.3:

Table 4.3: Distribution of questions into skill/concept areas

	Computational skills	**Understanding of basic concepts**	**Application of concepts and skills**	**Recall of basic facts**
	Q1 Q8 Q14 Q18 Q27 Q29 Q31 Q35 Q36 Q38 Q41	Q2 Q3 Q4 Q6 Q9 Q16 Q22 Q23 Q28 Q39 Q40 Q42 Q44 Q46 Q47 Q48 Q49 Q50	Q5 Q7 Q11 Q13 Q17 Q19 Q20 Q24 Q30 Q32 Q33 Q34 Q45	Q10 Q12 Q15 Q21 Q25 Q26 Q37 Q43
Total	11	18	13	8

Within the limitations of a written mathematical test, the aim was to include questions which covered the topic areas of number, measures, shape and pictorial representation, which simultaneously required the demonstration of the ability to work at different levels involving a range of concepts and skills (see Table 4.2). The mathematical content within the test includes:

Number: place-value; formal computation in the four number operations involving thousands, hundreds, tens and units; average; fractions of quantities; decimals to two places; money.

Measures: angles; points of a compass; weight; volume time in minutes and seconds; length; area; capacity.

Shape: reflection; parts of a circle; simple co-ordinates; names of plane and solid shapes.

Pictorial Representation: reading a scale; interpretation of a block graph; relationships; two-way entry table.

The questions on the paper when considered in terms of topic areas, are distributed as indicated in Table 4.4.

Table 4.4 : Distribution of questions into topic areas

Number		Measures	Shape	Pictorial Representation
Q1	Q24	Q3	Q2	Q7
Q4	Q27	Q10	Q9	Q16
Q5	Q28	Q12	Q13	Q39
Q6	Q29	Q17	Q15	Q44
Q8	Q31	Q22	Q26	Q45
Q11	Q34	Q25	Q32	Q46
Q14	Q35	Q30	Q37	Q48
Q18	Q36	Q33	Q42	Q49
Q19	Q38	Q43	Q47	
Q20	Q40			
Q21	Q41			
Q23	Q50			
24		9	9	8

The data considered here is based upon a correct/incorrect response to each of the 50 questions contained within the test paper. This data, based upon raw scores, is then analysed according to and in relation to the aims of this aspect of the study, as contained in Section 4.1.2.

The test instrument is primarily considered as a whole, i.e., each individual question being included as a means of enabling the test to fulfil its primary function as an assessment of overall mathematics achievement at a particular point in a pupil's mathematical career. That is, in this context, a summative assessment at the end of Key Stage 2 and not as a means of informing future teaching for this cohort. The interpretation of results of the test fall into two possible parts. A statistical appraisal of the scores derived from the test and a more qualitative assessment of how an individual pupil's performance on the test can assist in understanding progress made, with a view to providing the most appropriate learning experiences in the future. For example, if applying the test instrument as a means of establishing future experiences for the pupils, all incorrect responses need to be reviewed to establish if the error occurred as a result of (a) carelessness; (b) lapse of memory; (c) lack of understanding; or (d) the concept or process not having been met before. Errors which occur due to (a) and (b) indicate extra practice and revision is necessary. Errors due to (c) or (d) suggest further teaching is required.

As seen from the aims of the local study, attention is focused upon determining the trend in performance of children in mathematics at the end of Key Stage 2 throughout a twelve year period. Therefore the opportunity afforded by the test item to diagnose strengths/weaknesses of the pupils taking the test to inform further teaching on their behalf, will not be pursued within this study.

4.2.3 Analysis of Data Pre/Post Introduction of the National Curriculum

The data obtained across this twelve-year period is considered in a number of ways. Firstly in terms of year groups thus providing comparisons year on year throughout the period. Secondly the data is separated into two distinct parts that correspond to results obtained during the six years prior to the introduction of the National Curriculum (1983–1988) and results obtained during the six years post introduction of the National Curriculum (1989–1994). The subsequent analysis allows comparisons to be made in children's mathematical performance throughout the six years immediately before and after the introduction of the National Curriculum.

It is postulated that the National Curriculum has had a positive effect within primary schools. A result of this should be an overall improvement in children's performance in mathematical achievement and a continuing increase in children's mathematical competency within Key Stage 2. The available data is analysed to see if there is evidence to support this assertion.

The data is also analysed to compare performance by gender. In 1980 the Assessment of Performance Unit (APU, 1980) published a series of reports on the mathematical achievement of boys and girls at 11 and 15 years of age in England and Wales. A key finding was that while the achievement of girls and boys was comparable at age 11, the average scores for boys at 15 were higher than those for girls in all fifteen topics tested (significantly so in twelve of them). However, such results have always depended on the nature and content of the tests used. Consequently, further analysis of the present data focuses specifically upon aspects of overall mathematical achievement of children in terms of gender.

A further strand of the local study focuses upon the identification of specific elements within the test instrument causing particular difficulty for children. To enable this, item-level data available for the period 1992-1994 is examined independently of the twelve-year grouping. The nature of the data set allows the researcher to carefully examine individual pupil's responses to each of the 50 items on the test instrument, thus enabling the researcher to rank individual questions as well as the four separate sub-areas (understanding, computation, application or factual recall) within the test according to the level of difficulty experienced by the pupils. These elements are also investigated for gender bias. Additionally, pupils' responses will be considered in terms of the four topic areas of Number, Measure, Shape and Pictorial Representation. The sample of pupils considered for this aspect of study is n = 93, of which 45 are boys and 48 are girls.

4.3 NATIONAL STUDY

4.3.1 Research Design

Romiszowski (1992) notes that in any methodical approach to research the chosen method must be based upon the stated aims of the study. On the basis of the aims set for this aspect of the study (see Section 4.1.2), the survey approach is considered to be the most appropriate method to follow. The effectiveness of survey methods are elucidated by Kerlinger (1975) who suggests that such methods:

> *Focus on people, the vital information of people and their beliefs, opinions, attitudes, motivations and behaviours.*

It is possible to distinguish between two forms of survey research. Firstly the descriptive, and secondly the analytic. Descriptive surveys are informative in the sense that they tell how many members within a population have a certain opinion or characteristic. They are not designed to explain or to show causal relationships between one variable and another. Analytic surveys move away from enumeration and description to an analysis of causality. This research study belongs within this second form, the analytic type of survey.

Bulmer (1984) notes some of the limitations of survey research. For example, the incapacity to test hypotheses and the fact that some techniques and instruments employed are not always reliable. Alternatively, Oppenheim (1992) stresses that survey research is important, useful and very widely used within descriptive research procedures.

Mouly (1978) outlined the primary objective of survey research is to investigate the present status of the phenomenon. This aspect of the research design is wholly consistent with the aims of this study as previously presented, that is, to investigate the current status within schools in relation to key factors associated with achievement. Indeed, in this form of research, 'summative evaluation' must be impartial. Fox (1969) indicates the main aim of evaluation is to assist in making judgements about what should be happening in a learning situation and to discover what is actually happening, with the aim of sustaining, developing and improving that system. Therefore, in this case specific attention is drawn to the perceptions and opinions of head-teachers, deputy head-teachers and teachers, that is, those directly involved in the organisation, delivery and assessment process that surrounds National Curriculum mathematics within primary schools, and these are the people who are in regular contact with children. Evaluation is most successfully achieved by those directly involved in the activity.

The research design is significantly influenced by three factors, namely time limitations, sampling considerations, and financial constraints. With regard to time constraints, the local study required the permission of one head-teacher and the governing body of a single school in order to allow the research activity to be undertaken. However, the second stage of the study was on a much larger scale, involving 84 schools throughout Wales. This necessitated longer timescales for the process to be completed, for example, in terms of communicating with schools. Issues relating to sampling considerations are discussed in Section 4.3.7 (the sampling frame). Financial constraints relate to the fact that this project is purely self-funded on a part-time basis.

4.3.2 Research Questions

Clearly, a key element of any research project, as discussed by Cohen and Manion (1989), is the identification or formulation of hypotheses. However, it is also the case that some researchers generally agree that hypotheses are not necessarily suitable for every form of research activity and, as an alternative to hypotheses, research questions and/or objectives may be used. Therefore, two methods are used for stating specific problems to be investigated within this study:

- formulating hypotheses to be tested;
- listing the questions that the study has to answer.

This particular element of the study does not have any hypotheses for testing because its methodology is based upon survey research that is not specifically directed towards the testing of hypotheses. The central aim is to determine the impact of the National Curriculum as perceived by those practitioners throughout Wales who actually implement it. In order to achieve this, key factors associated with pupils' performance in mathematics and set within the contextual framework of the National Curriculum are investigated. In particular the research seeks to answer the research questions set out below.

- Has the National Curriculum provided benefits in terms of the knowledge gained by pupils?
- Has the National Curriculum enhanced schools overall ethos in relation to developing the affective domain of the pupils?
- In what way has the National Curriculum affected staff attitudes with respect to staff morale within the teaching profession?
- Has the National Curriculum created a climate in which staff may call upon colleagues expertise and experience in the form of support mechanisms for delivering the curriculum?
- Has the National Curriculum provided clarity in terms of the objectives and outcomes schools are able to set for their mathematics teaching?
- In relation to the content of the mathematics syllabus, does the National Curriculum provide a viable curriculum?
- Has the National Curriculum provided a catalyst for the development and refinement of curriculum methodology?
- Has the National Curriculum provided benefits in terms of improved relationships between the school and the wider external community?
- Has the National Curriculum initiated development and improvements in relation to mathematical textbooks available for delivering the subject?

- Has the National Curriculum provided clarity in relation to the adoption of specific subject teaching methodologies within schools?
- Has the National Curriculum improved the chances of raising standards in primary education?

In order to obtain data to provide answers to these questions it was decided to undertake a questionnaire survey of schools in Wales.

4.3.3 Questionnaire Design

The questionnaire is an instrument for collecting essential information from a chosen source. The use of a questionnaire within this study may be explained as a means of:

- eliciting data which may be used differently from simply describing a given practice;
- collating opinions, attitudes and judgements from which further evaluation may be derived;
- determining the current situation within a specific activity.

Oppenheim (1992) relates the term 'questionnaire' to postal questionnaires, group or self administered questionnaires, and structured interview schedules. He defines the questionnaire as an instrument for data collection that 'has a job to do; its function is measurement.' Clearly, that which is to be measured should be contained within parameters of the questionnaire. Davidson (1970) defines the ideal questionnaire as possessing the same properties as a good law, that is, it is clear, unambiguous and uniformly workable. The questionnaire in this study takes the format of self administered postal form.

Oppenheim, (1992) identifies the difficulty with planning detailed specification for a research project, that is, the overall result must be a full listing of every variable to be measured and the method to be used. Instrument development and questionnaire production cannot begin until the specification of variables requiring measurement and the form of instrument is complete. The suitability of items and the validity of the questionnaire must be given full consideration. Every item included on a questionnaire should measure a particular aspect of one of the study's objectives. The completion of lengthy questionnaires involves considerable time and effort, therefore by design, they should be both considerate and realistic. The questionnaire as a research instrument is useful only if it is well constructed and administered.

Questionnaires which require a free response in the respondent's own words are described as open-form or unrestricted. Such instruments are generally flexible, allowing respondents a degree of latitude when answering the questions. Oppenheim (1996) noted:

> *The chief advantage of the open ended questionnaire is the freedom that it gives to the respondents. Once he has understood the intent of the question, he can let his thoughts roam freely, unencumbered by a prepared set of replies.*

This framework allows respondents to reveal their attitudes, motives and expand their opinions. However, disadvantages of this framework include allowing respondents to misuse their freedom by possibly giving false information.

Alternatively, closed-ended questionnaires are restrictive, allowing the researcher to structure accurate responses according to the aims of the study. Such questionnaires are easier and quicker to complete and evaluate. Also, data gathered in this format are comparatively easier to use in statistical analysis and scientific generalisation. The disadvantage of the closed questionnaire is the difficulty to elicit the precise reasoning behind a given answer. This could therefore provide information of insufficient scope or depth.

The questionnaire as a research instrument has a number of strengths and weaknesses. The questionnaire enables greater geographical coverage and thereby reduces distribution bias. Additionally, the element of anonymity involved enables respondents to be frank and honest in their responses. Harris *et al.*, (1986) notes the impersonal nature of the questionnaire, its prescriptive wording and order of questions with instructions which allow some uniformity from one measurement situation to another. Disadvantages may arise in the form of poor or low response rates, responses not corresponding to behaviour and actual misinterpretation of the questions by respondents.

When constructing a research questionnaire many authors have written of particular question formats to avoid. For example, Cohen and Manion (1989) indicated pitfalls in questionnaire design which involve:

- leading questions;
- over complex questions;
- highbrow questions;
- use of negative terms in questions;
- open ended questions.

Borg and Gall (1983) outlined a framework for constructing research questions which ensure that:

- clarity is critical;
- short items are more appropriate than long items;
- negative items should be avoided;
- double-barrelled items should be avoided;
- technical terms, jargon and over complicated words should be avoided;
- biased or leading questions must be avoided. Oppenheim (1992) suggested some basic rules which should be supplied when considering the wording of items. In particular it is important to avoid:

- long words;
- double-barrelled questions;
- common or other popular sayings;
- double negatives;

- abbreviations, jargon, acronyms and over technical terms;
- ambiguity.
- leading questions;
- overtaxing the respondents memory.

For this study a closed questionnaire is used. This format is chosen on the basis of time and cost savings, its ability to gather specific data and the convenience of data processing for analysis. Specifically, that is,

- it is possible to achieve relatively inexpensive coverage of potential respondents (Cohen and Manion, 1989);
- if self administered, it requires less researcher time (Gay, 1987);
- it places less pressure on the respondents for an immediate reply (Kidder, 1981);
- subjects are given complete standardisation of instructions, which tends to lead to greater reliability and uniformity (Mouly, 1978);
- the limited number of response categories enables preparation of data for analysis relatively easy (Kidder, 1981);
- the anonymity may encourage respondents to provide more reliable data (Cohen and Manion, 1989).

In this study the questionnaire (see Appendix 4) is designed for administration to three key groups of people involved with the planning, organisation and teaching of mathematics within Key Stage 2, that is, head-teachers, deputy head-teachers and classroom teachers. On the basis of this the questions are designed to cover those key issues identified in Table 4.3, each of which is considered to have a direct effect upon children's achievement. These key issues were identified as a consequence of an extensive review of literature as discussed in Chapters 2 and 3. This exercise, along with the results of the local study (see Section 4.2) and the researcher's own considerable experience as a teacher and deputy head teacher, provided ideas regarding the direction in which to pursue this study and the type of questions to be asked.

Table 4.5: Key issues addressed within the questionnaire

Key Issues	**Number of Questions**
Section A	
Children's Knowledge	12
Children's Affective Domain	9
Teachers' Attitudes	9
Teachers' Support Mechanisms	8
Teaching Objectives/Outcomes	6
Curriculum Content	7
Curriculum Methodology	8
School – Community	5
Mathematical Textbooks	12
Mathematical Teaching Time allocated to Mathematics	10
General	1
Total questions Section A	***87***
Section B	
Respondent's Background Information	5
Total Questions Section B	**5**
Total Questions on Questionnaire	92

Items to be included were discussed in detail with the researcher's supervisor prior to designing and testing the initial questionnaire. This enabled a structured approach to be established with due consideration given to those sub-areas that should be included in relation to the aims of the study and the overall direction in which the study was to proceed. The detail of these questions was further informed by discussion with two mathematics advisors, 8 head-teachers, 8 deputy-head-teachers and 10 teachers, who were invited to comment on draft versions. This initial focus group provided a forum where practical comments could be provided and taken into consideration in the development of the questionnaire. Fowler (1984) notes the use of such expertise in the validation process of the research instruments is an acknowledged practice.

4.3.4 Description of the Questionnaire

The purpose of the questionnaire is to explore in detail the impact of the National Curriculum within the primary school classroom. Resulting from the extensive literature review and the detailed comments provided by the focus group, an instrument was developed with items that invited responses on a seven point Likert-type scale. This instrument was refined further after a first pilot study (see Section 4.3.5). Following the initial pilot and refinement of the instrument, a second pilot study was used to establish a reliability coefficient of the instrument (see Section 4.3.6).

The questionnaire used within this study (see Appendix 4), consists of two sections. Section A contains 87 questions divided into 11 groups as discussed above. In Section B, respondents are asked to record their gender, teaching position, qualifications, the number of mathematical courses attended and the number of years teaching experience they had gained.

To enable a subtle analysis of the responses, a seven point Likert-type scale is used. Point 4 on the scale, is the position where respondents judged the situation to be before the introduction of the National Curriculum and Standard Assessment Tests. If it is considered that changes affecting the introduction of the National Curriculum worsened the situation referred to, respondents were required to score their responses to the left of the neutral point on the scale (points 3, 2, 1). If it is considered that the changes improved the situation then respondents were required to move to the right on the scale (points 5,6,7). Point 1 of the scale represents the worst possible change and point 7 meant the best possible change. The questionnaire is of the restricted, or closed-form type, and respondents were required to circle the appropriate number on the evaluation scale for every statement.

The questionnaire was designed to elicit data from practitioners within schools, i.e., head teachers, deputy head teachers and teachers, based upon their perception of the impact of the statutory elements of the National Curriculum and its effect upon schools in relation to the items in the questionnaire. The twelve sections are linked directly with and derived from the eleven research questions contained in Section 4.3.2. A brief outline of each section follows:

Section A : Children's Knowledge

Research Question: Has the National Curriculum provided benefits in terms of the knowledge gained by pupils?

The twelve questions relate to what is considered an essential knowledge-base required by individual pupils to acquire further understanding and knowledge within the structure of the National Curriculum. A number of items focus upon essential literacy and numeracy skills along with the key skills and concepts of speaking and comprehension, which act dynamically to form a solid basis for further development and acquisition of knowledge.

In addition to the traditional computation element of mathematics, perceptions are also sought on the elements of problem-solving and investigative tasks, which have gained increasing significance in Key Stage 2 mathematics teaching post introduction of the National Curriculum.

Section B: Children's Affective Domain

Research Question: Has the National Curriculum enhanced schools overall ethos in relation to developing the affective domain of the pupils?

As discussed within Chapter 3, key factors are found to be advantageous and desirable for pupils to achieve to their fullest potential. Here the nine questions elicit data to investigate if the introduction of the National Curriculum has impacted upon developing the children's affective domain. That is, are children within Key Stage 2 developing in a positive, constructive way which ultimately will lead to a favourable disposition within school to facilitate further development and learning?

Quite essential is the concept that primary education is charged with the task of developing the 'whole' pupil, not simply striving for the 'academic' pupil. Therefore this section investigates a key element within good primary practice, that is, the development of the 'whole person' with nurturing a positive attitude and favourable outlook towards school, a key principle.

Section C: Teachers' Attitudes

Research Question: In what way has the National Curriculum affected staff attitudes with respect to staff morale within the teaching profession?

As a result of considerable disquiet throughout the stages of introducing the National Curriculum framework, many within the teaching profession have argued against the innovation in terms of workload, the number of changes and the pace of change within a short timescale and its adverse effect upon staff morale within schools.

Each item contained here has been associated with major changes over the past decade, changes in terms of increased activities, which possibly lead to the increasing claims of over workload and a lowering of staff morale in the profession, causing many to leave the profession to seek employment elsewhere.

Section D : Teachers' Support Mechanisms

Research Question: Has the National Curriculum created a climate in which staff may call upon colleagues' expertise and experience in the form of support mechanisms for delivering the curriculum?

This section investigates whether there is any improvement in support for practitioners from colleagues in the implementation of the National Curriculum within schools.

The basis for such investigation stems from two main considerations: Firstly, there is considerably more demand for depth of subject knowledge in the core and foundation subjects, particularly towards the end of Key Stage 2. Additionally, both schools and classrooms have become more 'open door' in outlook, where staff are monitored regularly in terms of performance and organisation from a variety of sources both in and outside of school. To enable teachers to assimilate such demands, a range of strategies are required in terms of support given to practitioners within schools.

Section E: Objectives/Outcomes

Research Question: Has the National Curriculum provided clarity in terms of the objectives and outcomes schools are able to set for their mathematics teaching?

The six questions investigate aspects of detailed organisation and planning which is involved in the teaching and delivery of mathematics within Key Stage 2. The key issues relate to elements outside the school, throughout the school and individually within the classroom, that is, objectives and outcomes.

Detailed planning is considered essential to enable improvement in delivery of the centrally controlled statutory curriculum within Key Stage 2, hence a positive perception on this research question is highly desirable in terms of improvement within schools.

Section F: Curriculum Content

Research Question: In relation to the content of the mathematics syllabus, does the National Curriculum provide a viable curriculum?

This section of seven questions is considered an essential element of a school's routine if the statutory National Curriculum is to be successfully implemented, for example, in terms of its primary objective of raising standards within schools.

The emphasis here is placed upon mathematics within Key Stage 2, in the context of the modern classroom. This section investigates whether there has been a change within the key generic items within curriculum content, post introduction of the National Curriculum.

Section G : Curriculum Methodology

Research Question: Has the National Curriculum provided a catalyst for the development and refinement of curriculum methodology?

The eight questions investigate key attributes associated with curriculum methodology which the researcher associates closely with successful teaching strategies within primary education.

Clearly, as identified within the literature review, the methodology chosen by schools to deliver the curriculum is paramount to the teaching process with each of the items contributing to a complex, dynamic process.

Section H: School-Community

Research Question: Has the National Curriculum provided benefits in terms of improved relationships between the school and the wider external community?

In recent years the community generally, with parents and industry in particular, are being encouraged increasingly by central government to become more involved with schools in many varied activities. This has taken the form of increased parental choice of schools for their children and more parental and industrial links in relationship to members of school governing bodies. Additionally, increasing links with industry in terms of improving funding opportunities and in relation to staff development and training.

This section investigates perceptions of school staff on whether the introduction of the National Curriculum has had an impact upon both parental and community links and relationships with the modern school.

Section I: Mathematical Textbooks

Research Question: Has the National Curriculum initiated development and improvements in relation to mathematical textbooks available for delivering the subject?

These twelve questions investigate the issue of the usage of mathematical textbooks as currently used and developed within schools. For many schools the textbook is a major resource and an essential instrument for the delivery of many aspects of the subject.

Within Welsh schools, as part of the National Framework, there are no directives or statutory guidelines as to which textbook to use when teaching the National Curriculum. Therefore this element of the project is essential in determining its development in schools to date.

Section J: Proportion of time/emphasis placed upon

Research Question: Has the National Curriculum provided clarity in relation to the adoption of subject specific teaching methodologies within schools?

The key factor of 'enabling' learning is the quality and provision of the teaching experienced. With the current situation of clearly defined objectives within the mathematics curriculum, which is broad and balanced to ensure progression and the realisation of the set objectives, teachers require a wide repertoire of teaching methods. This section investigates the impact of introducing the National Curriculum and the perceived effects upon teaching methods and strategies.

Section K General Question

Research Question: Has the National Curriculum improved the chances of raising standards in primary education?

This section asks the practitioners their perceptions as to whether changes made as a result of introducing the National Curriculum have improved or worsened the chances of raising standards in primary education. This element gets to the centre of the National Curriculum, with its key justification being an intentional raising of standards, which would satisfy the claims from many quarters that standards within primary education were declining.

The questionnaire is designed in such a way that related questions could be grouped as a single variable. The following dependent variables are studied:

DEVAR A Children's Knowledge

DEVAR B Children's Affective Domain

DEVAR C	Teacher's Attitudes
DEVAR D	Teacher's Support Mechanisms
DEVAR E	Teaching Objectives/Outcomes
DEVAR F	Curriculum Content
DEVAR G	Curriculum Methodology
DEVAR H	School - Community
DEVAR I	Mathematical Textbooks
DEVAR J	Mathematical Teaching Time
DEVAR K	General

The independent variables are:

- Gender
- Position
- Qualifications
- Number of mathematics INSET courses attended
- Number of years experience

A seven point Likert-type scale was chosen as this offers particular advantages in providing differentiation within the statistical analysis of the collated data. Scales differ from one another in two important ways, that is, according to their underlying level of measurement and their underlying level of precision. There are four levels of measurement and correspondingly, four types of scales. These are nominal scales, ordinal scales, interval scales and ratio scales. Understanding the type of scale used is essential because some statistical techniques require data collected at one level of scaling, while other operations require data collected at another. Knowledge of the level at which any given data has been collected thus gives information of which statistical operation may or may not be applied to the data set.

The data collected within this element of study is ordinal. Ordinal measurements produce scores which may be arranged in ascending order along some underlying dimension, in this instance, worst possible improvement through to best possible improvement. The underlying dimension is that of staff attitude to the effect of the introduction of the National Curriculum. An essential feature that distinguishes ordinal scaling is the fact that differences between points on an ordinal scale incorporate an element of direction; it is possible to say not only whether any two scores are different but also to specify the direction of that difference. The use of a seven point scale allows for differentiation between responses and is appropriate to a medium sized sample. Additionally, this format is selected as it corresponds to the chosen reliability procedures used (see Section 4.3.9) within the questionnaire design process of this study.

As the questions are in the form of attitudinal scaling, the data is recorded in terms of categories of responses given in the questionnaire, that is percentage perceiving a worsening situation, percentage perceiving no change in the situation and percentage perceiving an improvement in the situation. Consequently, the raw data is summarised by using frequency and percentage distributions. In addition a variety of non-parametric statistical techniques are used to analyse the data and draw conclusions. These include The Mann-Whitney U test, Wilcoxon and Chi-Square tests. The Mann-Whitney test may be used whenever a comparison is to be made between two independent samples of ordinal or higher level scores. Generally, the Mann-Whitney U test can be used to test the same type of research hypotheses as used with the t-test, the critical difference being the Mann-Whitney U test requires only ordinal level data, where the t-test requires at least interval level data. This is a non-parametric test of differences between the central tendencies of independent samples. The Mann-Whitney test may be used whenever a comparison is to be made between two independent samples of ordinal or higher level scores and the research hypothesis holds that the central tendency of the population from which the first sample was drawn is different from the central tendency of the population from which the second sample is drawn.

4.3.5 The First Pilot Study

A number of researchers, for example, Oppenheim (1992), have recommended that a questionnaire should be tested out via a pilot study prior to its use. The purpose of the pilot is to identify unquantifiable responses and un-interpretable comments and those questions which may be open to misinterpretation by respondents. Oppenheim (1992), also notes question quality and sequencing may be refined through piloting procedures, thus improving the extent to which responses are aligned to the research objective.

Consequently, the questionnaire was first piloted with 40 members of staff in 10 schools within one unitary authority/LEA in January 1997. The sample comprised of 22 (55%) females and 18 (45%) males. The respondents also covered a range of posts, that is, head-teachers (n = 8, 20%), deputy head-teachers (n = 8, 20%) and teaching staff (n = 24, 60%). In addition to completing the questionnaire all were asked to comment on any inappropriate wording or unclear aspect which they considered needed amending. As part of the instrument validation process (see section 4.3.10), these participants were requested, in addition to completing the questionnaire, to judge the items in relation to the criteria of ambiguity, relevancy, length and mode of response.

On the basis of this pilot study, the first draft of the questionnaire was modified. This took the form of ensuring the instructions for completing the questionnaire were more precise in requirement. That is:

- the instructions of how to score a response on the seven point scale (paragraph 1, Section A of questionnaire), were made more direct and simpler in form;
- further information and guidance relating to the meaning of each of the seven points of the scale was clarified for the respondents (paragraph 2, Section A of questionnaire);

It is considered the processes, development and refinement which the questionnaire went through up to this stage of construction were adequate in eliminating irrelevant, ambiguous and objectionable items (Oppenheim, 1992).

4.3.6 The Second Pilot Study

The whole instrument was piloted once more in order to obtain an indication of its validity and reliability. The second sample for this pilot study were selected from primary schools within the two Education Authorities in South Wales. The sample of 50 staff was made up of:

6 Head teachers (50% male, 50% female);
6 Deputy Head-teachers (50% male, 50% female);
38 Teachers (50% Male, 50% Female).

These participants were contacted personally by the researcher, who discussed and outlined the requirements. Each was given a copy of the questionnaire and following completion and return, these were analysed in terms of validation procedures (see Section 4.3.10) and reliability (see section 4.3.9). The time schedule for this pilot study, which allowed the researcher to contact slower respondents, was 6 weeks, commencing in February 1997.

4.3.7 Sampling Frame

This study was confined to Wales. The nature of the research questions made it necessary to focus upon teachers currently involved in the teaching of National Curriculum mathematics at Key Stage 2. This group of people are considered to have the necessary, first hand experiences of teaching within this framework and therefore their opinions are deemed likely to reflect the reality of the situation at the time of this study.

In order to select an appropriate sample the researcher obtained a list of all primary schools in Wales within each of the 22 Unitary Education Authorities, from the Welsh Office Statistical Department, Cardiff. A letter was sent to each of the 22 Directors of Education within Wales (see Appendix 5), inquiring if they would allow the researcher to contact schools individually to seek the permission of head-teachers and governing bodies, to permit their school to participate in the research survey. Each letter was accompanied by two copies of the questionnaire to be used in the study.

After several communications (written and telephone conversations), between the researcher and the Directors/Assistant Directors of Education, of the 22 Unitary Education Authorities in Wales:-

- all responded to the researchers letter, either in writing or by telephone;
- twenty-one Authorities responded positively, agreeing for the researcher to proceed;
- one Authority responded negatively, as a result of 'intolerable pressures on staffing', the Director of Education felt the Authority could not participate in the study.

The sample was then randomly identified and chosen from those Key Stage 2 schools within each of the 21 Education Authorities participating in the study. Currently, within the state sector of education there are 1680 schools in Wales which engage in the teaching of mathematics at Key Stage 2. Thus, for the purposes of this study, the final version of the questionnaire was administered to a range of teaching staff, that is, head-teachers, deputy head-teachers and teachers, in a 5% stratified random sample of schools. In order to achieve this sample each school within the 21 participating Education Authorities was allocated a number, thus ensuring that the Unitary Authorities were 'weighted' to take account of their size. These numbers were then randomly selected until the desired number of schools was realised. Consequently, a sample of 84 schools was involved in this study involving 21 of the 22 Education Authorities within Wales. Within this 5% sample, five members of staff from each chosen school were invited to participate in the completion of the questionnaire. To make these invitations the researcher wrote letters to the 84 head-teachers of chosen schools within each of the twenty-one participating Authorities, inviting their schools to participate in the research survey (see Appendix 6).

In addition to these introductory letters, the researcher mailed 420 questionnaires to the Head-teachers of these schools as contact persons (5 questionnaires to each of the 84 selected schools), who in turn distributed the questionnaires to members of staff within each school. Unless requested by individuals for further information or clarification of points, the researcher had no direct contact with participants. No participants contacted the researcher.

4.3.8 The Questionnaire Schedule

This element of the study required introductory letters to:

- the Director of Education for each of the 22 education Authorities in Wales;
- the head-teachers and governing bodies of selected schools;
- the teachers participating within each of the schools within the sample (see Appendix 7).

The letters sought permission to undertake such research activity by using a questionnaire as a research instrument and inviting staff to participate. This process was completed by April 1997.

A printed questionnaire was administered to respondents by mail in May 1997. A letter was attached which explained the purposes of the research, along with instructions for completing the questionnaire. A stamped addressed envelope was provided for the return of each individually completed questionnaire, which was scheduled for Thursday, 31st July 1997. All respondents were guaranteed anonymity and confidentiality. The time scale involved here was twelve weeks for the participants to complete and return the questionnaire through the postal service.

Of the four hundred and twenty questionnaires sent out to the stratified random sample of eighty four schools, 274 were completed and returned, giving a response rate of 65.2%. According to literature on research methods, there is no agreement as to the correct sample size within a survey research of this nature. Bell (1987) points out:

> *The correct sample size depends upon the purpose of the study, design of the study, data collection methods used and the nature of the population under scrutiny.*

However, Cohen and Manion (1989), insist there is need to obtain the 'minimum sample size' that will accurately represent the population under scrutiny. Within the constraints of this study the response rate of 65.2% of the targeted schools (a 5% random sample), is considered appropriate for meaningful results. The sample is considered to be large enough to be representative of the target population, that is, all primary schools in Wales. All uncompleted cases will be treated in the analysis as missing cases.

Regarding sample size, Borg and Gall (1989) argued that the larger the sample, the more likely are its mean and standard deviation to be representative of the population. Alternatively, Youngman (1979) notes results from small samples have little general applicability. Youngman (1979) viewed 200 cases as an acceptable minimum in order to get stable correlational coefficients between variables. The two hundred and seventy four respondents in this study represent an acceptable sample size on the basis of these earlier studies.

4.3.9 Reliability of the Instrument

Kerlinger (1973) defines reliability as 'The relative absence of errors of measurement in a measuring instrument'.

An instrument is considered reliable if over a period of time it measures consistently (Best, 1981). Oppenheim (1992) added reliability includes both the characteristics of the instrument and the conditions under which it is administered, both of which must be consistent. Best (1981) points out the reliability of an instrument can be calculated statistically and may be expressed as a coefficient of correlation. There are a range of techniques available to compute various coefficients of reliability, for example, test-retest method or test of stability, equivalent or parallel forms and split-half or internal consistency.

The test-retest method involves the same test administered on two occasions to the same group of people separated by a period of time. The correlation obtained is called the coefficient of stability. The parallel forms measurement of reliability involves the administration of two forms of a test to the same group. These two forms of test are constructed to measure the same characteristics. The correlation obtained is known as the coefficient of equivalence. The split-half method is another approach. The method involves a single administration of the instrument. The test is split into two halves, scored separately and results correlated. The result obtained is known as the coefficient of internal consistency.

This study uses the split-half or internal consistency method to establish an estimation of the coefficient of reliability. The advantages of this method are the questionnaire is administered to a sample of respondents on only one occasion, also the co-operation of a sample of respondents is required for a single period of testing. Anastasi (1976) notes from a single administration of one form of instrument, it is possible to measure the coefficient of reliability using a range of split-half procedures. These practical advantages have led test designers to use internal consistency procedures frequently. However, criticisms of this approach note all testing is done within a single brief period, therefore no evidence can be obtained on a respondent's performance from one occasion to another. Downie and Kelly (1978) also note that internal analysis cannot be used with tests requiring speed or time restraints in completion.

Anastasi (1988) notes some tests have multiple-scored items, where respondents have to choose among different variances and thus receive a range of numerical scores on each item. Borg and Gall (1989) note when responses are not scored dichotomously, for such instruments a generalised formula known as coefficient alpha has been derived. The instrument within this study complies with the criteria identified by Anastasi (1988) and Borg and Gall (1989), that is items are not scored dichotomously, but rather respondents have to select among different variants, that is, on a seven point scale ranging from point 1 (the worst possible change), to point 7 (the best possible change).

The alpha coefficient (see Appendix 8) calculated for the reliability of the instrument used in this study yielded the following result:

Number of cases = 50

Reliability coefficient for 92 items

Alpha = 0.9960 Standardised item alpha = 0.9963

This level of reliability obtained is highly significant and therefore it is safe to proceed with the process of validation.

4.3.10 Validity of the Instrument

Validity is the extent to which a mechanism actually achieves its aims or measures what it sets out to measure. Therefore before using any procedure it is necessary to ensure it is a valid procedure. Kidder (1980), noted:

> *Every instrument must pass the face validity test either formally or informally. Every researcher who has decided an instrument is a judge who had decided that the test measures the construct that he or she wishes to measure.*

Burroughs (1971) notes that no test has universal validity, only validity in relation to the particular population for whom it is designed, the purpose for which it is designed and the conditions under which it is to be administered. There are many forms of validation for an instrument. However, many authors, for example Anastasi (1988), discuss three forms of validation, that is, content validity, construct validity and criterion related validity.

Content validity as discussed by Borg and Gall (1989), relates to the degree to which the items within an instrument represent the content of which the instrument is designed to measure. Downie and Kelly (1978) state content validity is a non-statistical process of validation which is often accomplished and assured when the designer of the instrument completes an adequate task when selecting items for inclusion in the instrument. Kerlinger (1977) considers content validation consists essentially in judgement. Individually or with others within focus groups, each item must be judged on its presumed relevance to the property being measured. Zeller (1988), along with Borg and Gall (1989), considers content validation is completed by systematically undertaking a set of operations such as, defining the specific parameters to be sampled, detailing objectives and selecting samples which represent the specific content parameters. Anastasi (1988) stresses content validity must not be mistaken with face validity. The latter refers not to what the test actually measures, but to what it appears to measure. Throughout the process of constructing the instrument in this study considerable effort has been made to ensure that which is measured by the instrument is related to the aims and objectives of the study.

Best (1981) defines construct validity as 'the degree to which scores on a test can be accounted for by the explanatory constructs of sound theory'. The development of an instrument that is based upon a range of sources of information should produce an acceptable level of construct validity. Anastasi (1988) suggests that:

> *construct-related validation requires the gradual accumulation of information from a variety of sources. Any data throwing light on the nature of the trait under consideration and the conditions affecting its development and manifestations represent appropriate evidence of this validation.*

Criterion validity is the correlation between a set of scores with one or more external measures or criteria, known or believed to measure the attribute under study (Anastasi 1988). There are essentially two forms of criterion validity, that is concurrent validity and predictive validity. Zeller (1988) states 'concurrent validity describes a criterion related validity situation where the criterion variable exists at the present', while 'predictive validity describes a criterion-related validity situation where the criterion variable will not exist until a later point in time.' The criterion validity is primarily statistical.

Cronbach (1970) considers the validation of tests in relation to the purposes the tests are constructed for. Tests are designed for making decisions about the individuals tested and for describing them. In the former situation, validation is criterion-orientated, while in the latter situation, validity is content and construct related.

Fox (1969) notes for research instruments such as questionnaires, content validity is the soundest technique available to the researcher. In attempting to develop content validity of the questionnaire used within this study, items included were initially derived from an extensive review of literature and a personal knowledge of the Key Stage 2 classroom environment. At every stage of its design, the items within the questionnaire were repeatedly checked to remove any inconsistencies and ambiguities. To achieve a high degree of validity the items went through several stages and processes of validation as outlined in the earlier sections within this chapter.

4.3.11 Responses to the Survey Questionnaire

The introduction of the National Curriculum and its assessment framework developed considerable controversy in some quarters, culminating in a teachers boycott of the assessment arrangements during the first stages of their introduction (see Chapter 1, Section 1.4.7). Issues at the forefront of the controversy were based upon the pace of the implementation of the innovation and, more especially, the introduction of the Standard Assessment Tests at the end of the four Key Stages.

To reduce the potential of any biased responses which may develop from such controversy, four elements were considered. Firstly, in each of the written communications sent to (a) the Directors of Education, (b) the Head teachers of schools, and (c) the teaching staff participating in the survey, clearly the contents emphasise and focus upon the mathematical performance of children, along with the examination of 'aspects of mathematics teaching and learning in primary schools' and the 'mathematics teaching situation in primary schools', from the viewpoint of practitioners organising and delivering the curriculum within Key Stage 2.

Secondly, within each of the twelve dependent variables contained within the questionnaire (containing 87 questions) not one item related to the introduction of the Standard Assessment Tests, and there was no requirement for participants to focus upon this issue.

Thirdly, at every stage of introducing, completing and returning this closed, strictly confidential and anonymous questionnaire, all participants, i.e., the Directors of Education of 22 Authorities, 84 Head teachers, 84 Deputy Head teachers and 252 teachers, were given the contact address and telephone number of the researcher if further guidance, clarification and assistance on any aspect was required. Not one participant sought clarification or assistance.

Fourthly, the eleven research questions relating to this aspect of the study (see Section 4.3.2) were included in the information for participants. This enabled two things: (i) the participants could clearly see there was no 'hidden agenda' or 'covert motives' in seeking their viewpoints, and (ii) the clear, direct linkage between the eleven research questions and the eleven sections of the questionnaire allowed respondents to gain an insight and fuller understanding of the contextual nature of each item contained in the questionnaire as an aid to the purpose and requirements of the survey questionnaire.

Therefore, on the basis of these considerations and the procedural methods used and described within this methodology section, the researcher considered the questionnaire appropriate for distribution to the sample of Welsh schools, also being fully confident in the professional judgement, expertise and integrity of those participating and that participants would respond in an unbiased and fair-minded way.

4.4 SUMMARY

4.4.1 Statistical Analysis of Data

For the statistical analysis of the data collected within this study the SPSS 7.5 for Windows, Statistical Package for Social Science will be used. Statistical analysis will be used to confirm the characteristic of the data set to establish with a high degree of confidence, that such a characteristic did not arise by chance and is therefore robust. To enable this, measurement of the level and dispersion of the set of raw scores will be undertaken as outlined by Hartwig and Dearing (1979), who strongly advise exploratory data analysis (EDA), as a key starting point for such work.

Exploratory data analysis within this report uses proportions and percentages followed with Chi-Square and Wilcoxon statistical analysis. The clear aim of implementing an exploratory data analysis within this study is to identify atypical scores or outliers and determine if they exert undue influence or leverage upon statistical values gained.

The Mann-Whitney U test, will be used for making comparisons of the dependent and independent variable within the data set. Both these tests are non-parametric statistical techniques which compares the central tendency of two groups.

4.2.2 Limitations of the Study

The findings of the present study apply to the specific sample and need to be interpreted carefully. Similarly any implications that emerge for school practice refer to the sample only. However, this does not mean that these results may not be applicable to other Welsh schools, staff and pupils. The rigorous sampling techniques followed in this study, involving Education Authorities, schools, staff and children from a range of locations within Wales are likely to mean that interpretations, inferences and conclusions drawn are more applicable .

Some limitations of this survey relate to the inherited features of the main instrument used, that is, the questionnaire. The study largely relies on the perceptions and opinions of the respondents. As discussed within this chapter, questionnaires often limit the information collected by the questions asked, the order in which they are asked, and the respondents lack of opportunity to comment on their answers. However, a detailed and thorough methodology was followed in attempting to develop the instrument, so that it would provide accurate and meaningful information about the issue under investigation.

4.4.3 Chapter Summary

This chapter is devoted to the research methodology used in the study. In the first part the purpose and aims of the study were outlined. The second section of this chapter gave a description of the local element of the study. This was followed by a description of the National Study, outlining the development of the research instrument, with the sample selection process outlined along with the method of implementing the instrument. Finally, a general outline of the statistical analysis to be used was given, along with a brief description of the limitations of this study. In the following chapters research findings are discussed and results presented.

CHAPTER 5

THE LOCAL STUDY

5.1 INTRODUCTION

This chapter presents the findings of the local study that investigates children's performance in mathematics over the twelve year period 1983 to 1994. The main aims of the local study were described in Chapter 4. Summarising, these are to:

- compare pupil's overall mathematical achievement throughout the twelve-year period 1983 to 1994 in order to establish whether evidence exists to substantiate the claim that mathematical competency is in decline;

- identify any significant differences that occur in mathematical performance between boys and girls;

- investigate pupils' mathematical performance in specific areas in order to determine those aspects of the mathematics curriculum that provide the greatest difficulty for pupils at this age.

The results are presented in three sections that correspond to the three points outlined above.

5.2 PERFORMANCE OF PUPILS OVER THE PERIOD 1983-1994

5.2.1 General characteristics and trends within the sample

For the purpose of this study, the total sample size is n = 766. This equates to an average cohort of 64 pupils per year and is considered to be of adequate size for the identification of trends in children's mathematical achievement within this school over the twelve years. Table 5.1 and Figure 5.1 show the frequency of pupils within each of the twelve years considered. There is considerable fluctuation with a noticeable decrease in pupil numbers within the school, year on year. This clearly introduces issues of teacher/pupil ratios, loss of staff and hence changes in school and classroom organisation, all of which affect achievement of pupils and contributes towards standards within schools. These factors will be investigated in detail within the national element of this study.

Table 5.1 : Frequency of pupils by year

Year	Frequency
1983	72
1984	57
1985	73
1986	64
1987	61
1988	81
1989	98
1990	107
1991	60
1992	29
1993	27
1994	37
Total	766

The scores achieved on the test instrument within this period range from 4 to 50 (the maximum possible score). The distribution of marks is shown in Figure 5.2, while a table showing the frequency and cumulative percentages of marks is to be found in Appendix 9.

It can be seen that a substantial number of scores were achieved by a relatively small number of pupils. For example, a mark of 15 was scored by only 2 out of the 766 pupils, a mark of 23 by 7, a mark of 30 by 19 etc. Consequently the distribution is not normal. Over 70% of pupils achieved a score of 25 or more marks out of 50. Since the test provides good coverage of the National Curriculum Programme of Study, this indicates a good standard of achievement in mathematics on the instrument by the pupils within this sample Overall, the mean score achieved is 29.39 while the standard deviation is 8.15; year on year averages and standard deviations are shown in Table 5.2.

The year-on year trend is illustrated in Figure 5.3, where a clear improvement in performance over time is seen. This is evident particularly during the last five years considered, i.e., 1990-1994.

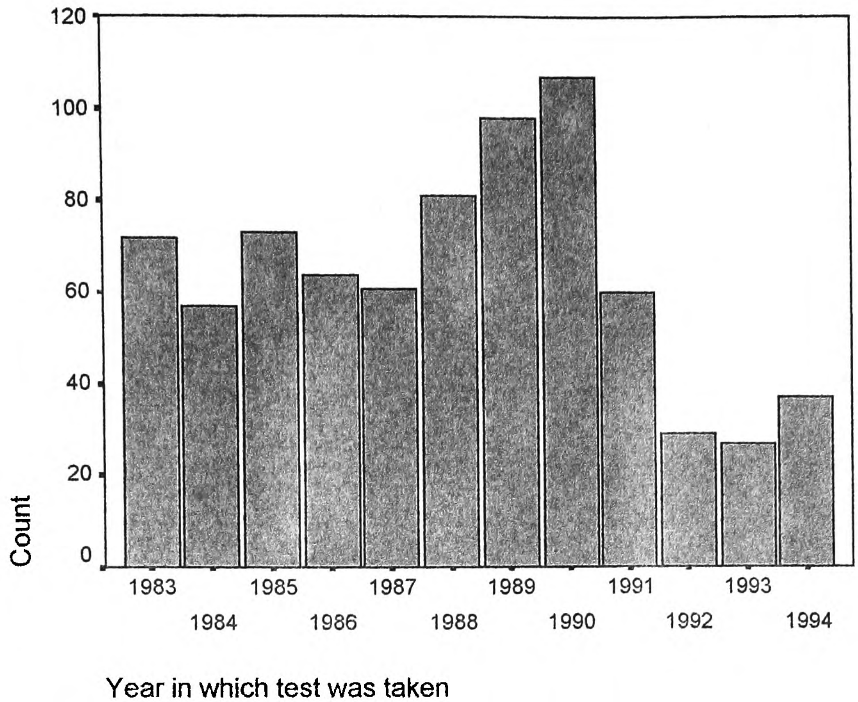

Figure 5.1 Frequency of participants by year

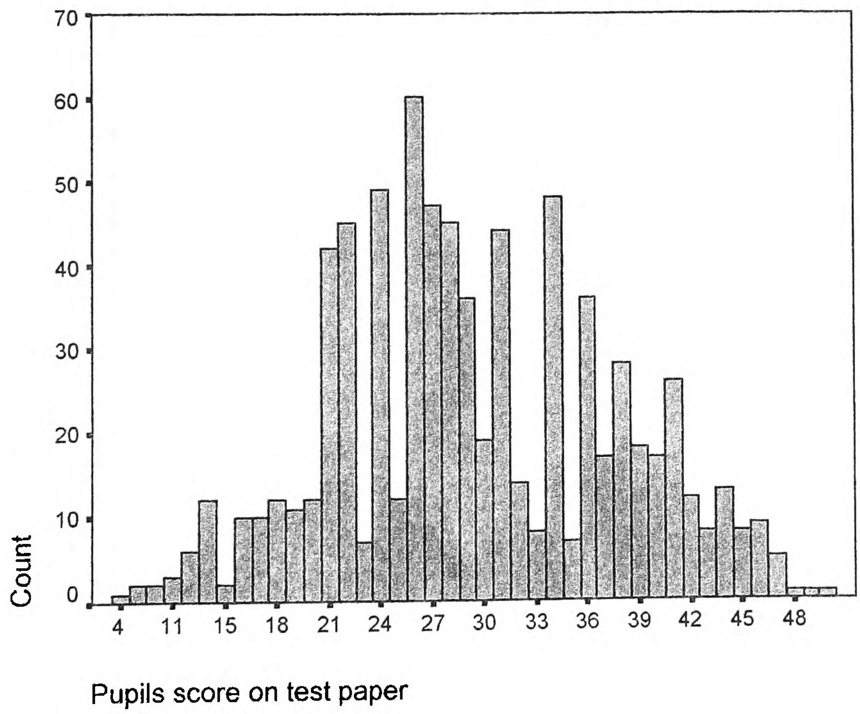

Figure 5.2 : Distribution of scores, 1983-94

Table 5.2 : Pupils mean scores and standard deviations by year

Year	Mean	N	Std. Deviation
1983	32.12	72	7.48
1884	31.32	57	8.42
1985	28.92	73	7.63
1986	27.70	64	7.40
1987	27.62	61	8.30
1988	28.10	81	7.15
1989	26.83	98	6.32
1990	25.82	107	6.63
1991	28.23	60	6.56
1992	35.17	29	8.07
1993	40.56	27	5.62
1994	36.92	37	9.79
Total	29.39	766	8.15

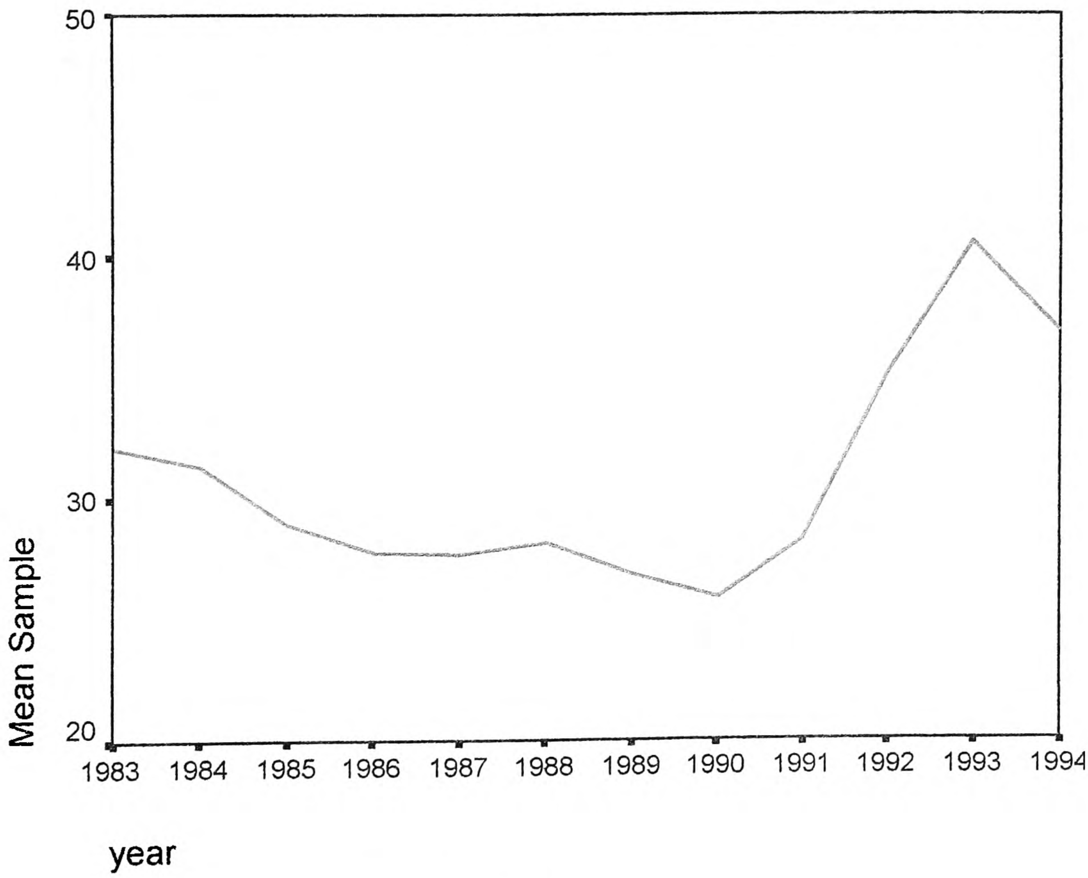

Figure 5.3 : Mean scores achieved on the test instrument against year

5.2.2 Year on Year Comparisons

Statistical analysis was undertaken to establish if there were any significant differences in achievement between each of the twelve year groups. The hypotheses considered were:

> H_0: there is no significant difference in scores between year groups
> H_1: there is a significant difference in scores between year groups

As a preliminary to the statistical analysis, stem and leaf plots were compiled for each of the twelve years, 1983 to 1994 (see Appendix 10). An example of these is shown in Figure 5.4. Such examination of the nature of the sample is essential in confirming the appropriateness of statistical instruments for use during further analysis of the data.

Pupils score on test paper Stem-and-Leaf Plot for
YEAR= 1983

Frequency	Stem & Leaf
2.00	1 . 24
3.00	1 . 678
5.00	2 . 14444
18.00	2 . 666667777788888899
14.00	3 . 00111123444444
17.00	3 . 56666677788888899
12.00	4 . 001111122333
1.00	4 . 5

Stem width: 10
Each leaf: 1 case(s)

Figure 5.4 : Stem & Leaf Plot - Pupils Performance in 1983 Test

The Wilcoxon rank sum test was applied to each pair of year group combinations to investigate the stated hypotheses. Table 5.3 shows 23 of the 66 possible combinations in which H_0 was accepted. For these combinations there were no significant differences in mean scores between the years indicated.

Table 5.3 : Comparison between year groups

Year Group	Z value	Sig.	Year Group	Z Value	Sig.
1983 – 1984	-0.496	.620	1986 – 1991	-0.108	.914
1983 – 1992	-1.725	.085	1987 – 1988	-0.151	.880
1984 – 1985	-1.949	.051	1987 – 1989	-0.988	.323
1985 – 1986	-0.797	.425	1987 – 1990	-1.895	.058
1985 – 1987	-0.667	.505	1987 – 1991	-0.125	.901
1985 – 1988	-0.652	.514	1988 – 1989	-1.354	.176
1985 – 1989	-1.838	.066	1988 – 1991	-0.098	.922
1985 – 1991	-5.526	.599	1989 – 1990	-1.277	.202
1986 – 1987	-0.087	.931	1989 – 1991	-1.155	.248
1986 – 1988	-0.273	.785	1992 – 1994	-1.261	.207
1986 – 1989	-0.966	.334	1993 – 1994	-1.389	.165
1986 – 1990	-1.911	.056			

Consequently, 43 of the 66 year groups did exhibit a significant difference in mean scores between the two groups considered. In particular, each of the years 1994, 1993 and 1992 were statistically different from any other year (with the exception of 1983-1992). Taking this evidence, along with the trend shown in Table 5.3 allows one to refute the suggestion that standards are falling in mathematical achievement. Indeed the analysis shows a significant improvement in performance in 1992, 1993 and 1994. It is possible to speculate that this may have occurred as a result of the introduction of the National Curriculum in 1988 and its subsequent implementation classrooms after this time. This aspect is considered further in the next section.

5.2.3 Comparison of Results pre and post National Curriculum

In order to investigate further the effect of the introduction of the National Curriculum the data was arranged into two groups. The first of these spans the 6 years immediately before the introduction of the National Curriculum (1983 to 1988), while the second includes the 6 years immediately after (1989 to 1994). The mean scores and standard deviations of pupils in these six year periods are shown in Table 5.4.

Table 5.4 : Summary data over six year period either side of the introduction of the National Curriculum

Results over the six year period before the introduction of the National Curriculum	Mean Standard Deviation Sample Size	29.27 7.85 408
Results over the six year period after the introduction of the National Curriculum	Mean Standard Deviation Sample Size	29.52 8.48 358
Total over twelve year period	Mean Standard Deviation Sample Size	29.39 8.15 766

The summary data appears to suggest that throughout this period very little if any variation in children's mathematical achievement occurred within this sample. The application of the t-test to compare the means of the distribution in the six year periods before and after the introduction of the National Curriculum confirms this. Consequently, this comparison does not allow us to draw conclusions concerning significant differences in performance over the six year periods either side of the introduction of the National Curriculum. However the fact remains that there is a noticeable improvement in mean scores over the last three years of the period.

5.3 DIFFERENCES IN MATHEMATICAL PERFORMANCE BETWEEN BOYS AND GIRLS

5.3.1 General characteristics and trends within the sample

This section investigates whether any significant differences exist in the performances of the boys and girls who participated in the test. Table 5.5 shows the sample distribution in terms of gender, while the distribution of scores by gender is shown in Table 5.6. As a preliminary it is interesting to note that 109 of the 377 boys (28.9%) and 117 out of 389 girls (30.1%) scored less than half marks in the test.

Table 5.5 : Sample size by gender within each of the twelve years

		Gender of children taking test paper		Total
		Boy	Girl	
Year in which test was taken	1983	43	29	72
	1984	27	30	57
	1985	30	43	73
	1986	32	32	64
	1987	29	32	61
	1988	43	38	81
	1989	41	57	98
	1990	59	48	107
	1991	28	32	60
	1992	15	14	29
	1993	12	15	27
	1994	18	19	37
Total		377	389	766

Table 5.6 : Distribution of scores by gender

		Boy	Girl	Total
Pupils score on test paper	4	1		1
	6	1	1	2
	9		2	2
	11	2	1	3
	12	2	4	6
	14	4	8	12
	15	1	1	2
	16	6	4	10
	17	4	6	10
	18	7	5	12
	19	6	5	11
	20	6	6	12
	21	15	27	42
	22	23	22	45
	23	4	3	7
	24	27	22	49
	25	6	6	12
	26	32	28	60
	27	23	24	47
	28	21	24	45
	29	18	18	36
	30	12	7	19
	31	23	21	44
	32	6	8	14
	33	5	3	8
	34	21	27	48
	35	7		7
	36	13	23	36
	37	7	10	17
	38	15	13	28
	39	6	12	18
	40	9	8	17
	41	14	12	26
	42	7	5	12
	43	5	3	8
	44	5	8	13
	45	5	3	8
	46	2	7	9
	47	4	1	5
	48		1	1
	49	1		1
	50	1		1
	Total	377	389	766

The mean scores attained by boys and girls over the twelve year period are compared in Table 5.7. These results indicate that very little difference in achievement appears to exist between genders within the sample.

Table 5.7 : Mean Score in relation to gender

Report

Pupils score on test paper

Boy	Mean	29.47
	N	377
	Std. Deviation	8.09
Girl	Mean	29.30
	N	389
	Std. Deviation	8.21
Total	Mean	29.39
	N	766
	Std. Deviation	8.15

The children's distribution of scores throughout the twelve year period, in terms of boys and girls, are illustrated separately in Figures 5.5 and 5.6.

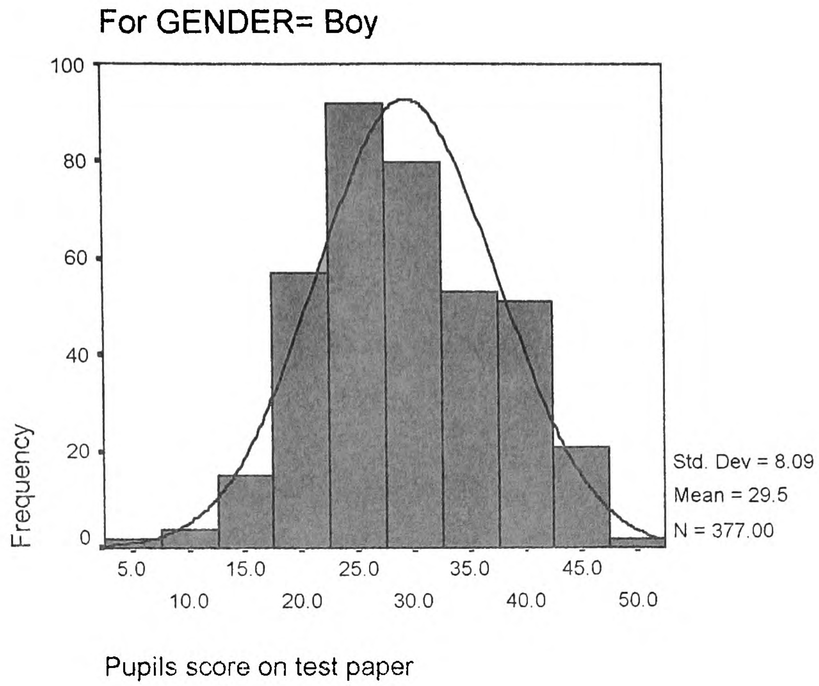

Figure 5.5 : Boy's Score Distribution throughout the twelve years

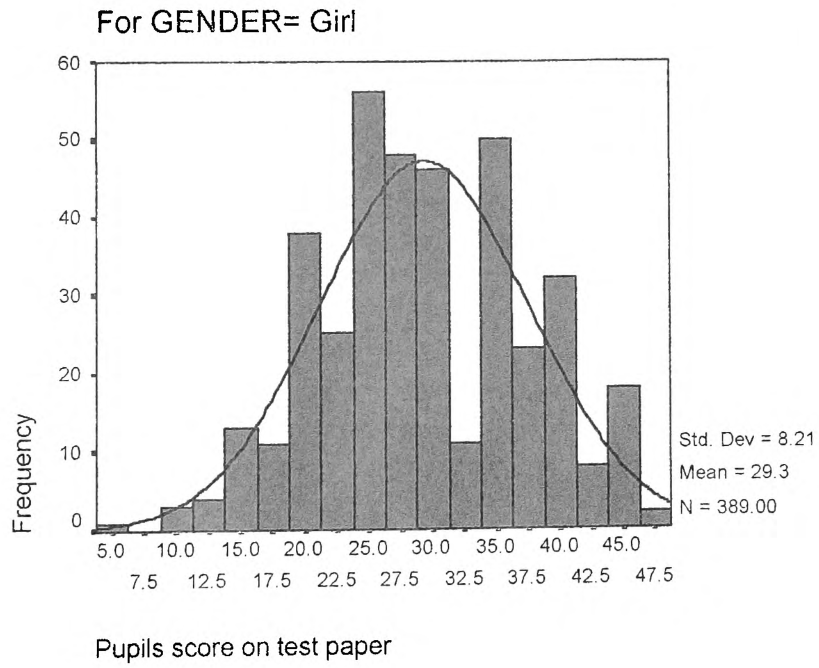

Figure 5.6 : Girls Score Distribution throughout the twelve years

The Wilcoxon rank sum test was applied to consider the pupils' mathematical achievement in relation to gender. Therefore, Considering the hypothesis:

H_0: There is no difference in mathematical achievement between boys and girls on this test instrument

H_1: There is a difference in mathematical achievement between boys and girls on this test instrument.

A Z-score of –23.982 was obtained indicating a highly significant result. Consequently the null hypothesis was rejected, and it was deduced that there is a difference in mathematical achievement between genders on this test instrument.

5.3.2 Year on year comparisons

In this section the overall results are broken down by year so that detailed comparison of achievement between boys and girls can be made year on year (see Table 5.8).

Table 5.8 : Year on year mean scores by gender

Year	Sample (Mean)	Boy (mean)	Girl (Mean)
1983	32.12	31.56	32.97
1984	31.32	31.52	31.13
1985	28.92	28.97	28.88
1986	27.70	27.53	27.88
1987	27.62	25.14	29.88
1988	28.10	28.93	27.16
1989	26.83	26.61	26.98
1990	25.82	25.53	26.19
1991	28.23	28.64	27.88
1992	35.17	36.80	33.43
1993	40.56	41.25	40.00
1994	36.92	40.83	33.21

These findings are illustrated in Figure 5.7 where the trends are plotted separately for boys and girls. Clearly, three years in particular show noticeable differences between the performances of boys and girls, that is, 1987, 1992 and 1994.

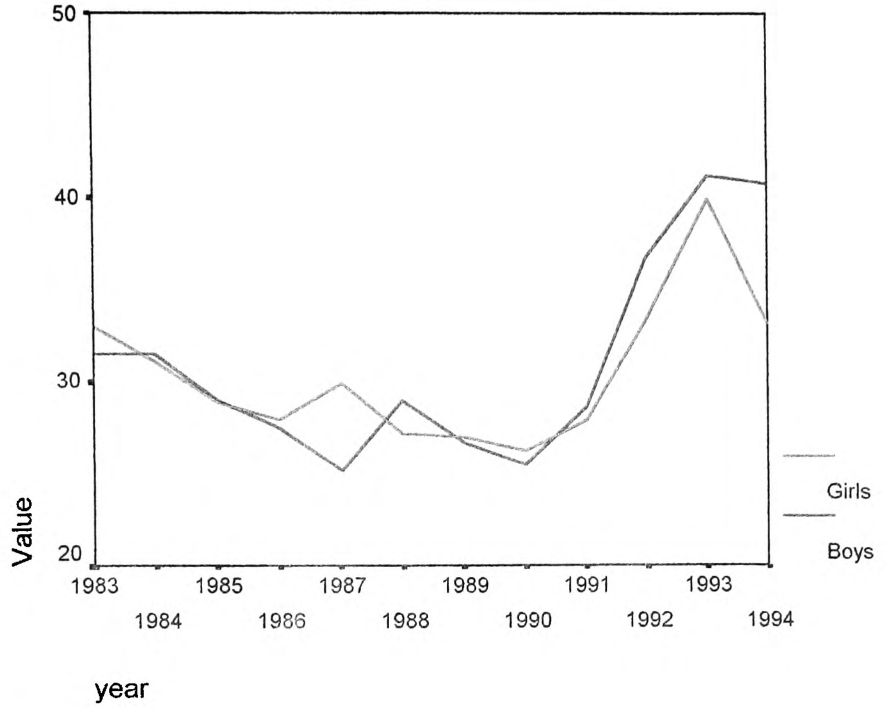

Figure 5.7 : Mean scores of boys and girls over the twelve year period

5.3.3 Comparison of results by gender, pre and post National Curriculum

The results were analysed to see if there were any significant gender differences apparent in the six year period pre and post introduction of the National Curriculum. Table 5.11 shows the numbers of boys and girls considered, while Table 5.12 shows the relevant mean scores obtained.

Table 5.9 : Gender distribution within sample

Results recorded before/after introduction of the National Curriculum * Gender of children taking test paper Crosstabulation

Count

		Gender of children taking test paper		Total
		Boy	Girl	
Results recorded before/after introduction of the National Curriculum	Results before introduction of the National Curriculum	204	204	408
	Results after introduction of the National Curriculum	173	185	358
Total		377	389	766

Table 5.10 : Mean scores by gender against pre/post National Curriculum

	Boy (Mean)	Girl (Mean)	Sample (Mean)
Before NC	29.07	29.47	29.27
After NC	29.95	29.11	29.52

Table 5.10 confirms that within this sample there appears to be no differences in achievement between boys and girls, either six years before or six years after the introduction of the National Curriculum.

Considering the hypothesis:

H_0 : There is no difference in achievement between boys and girls either six years before or six years after the introduction of the National Curriculum

H_1 : There is a difference in achievement between boys and girls either six years before or six years after the introduction of the National Curriculum.

The results of the t-test shown below confirm there is no significant difference in achievement of boys and girls either six years before or 6 years after the introduction of the National Curriculum.

Table 5.11 : t-test for differences in achievement between genders

	Test value = 0					
					95% Confidence Internal of the Difference	
	t	dt	Sig. (2-tailed)	Mean Difference	Lower	Upper
Pupils score on test paper	99.837	765	.000	29.39	28.81	29.96
Results recorded before/after introduction of the National Curriculum	81.344	765	.000	1.47	1.43	1.50
Gender of children taking test paper	83.419	765	.000	1.51	1.47	1.54

5.4 ASPECTS OF MATHEMATICS CAUSING DIFFICULTY FOR PUPILS

5.4.1 Difficulties encountered with individual questions and categories of question – whole sample analysis

In this section of the study, pupil's mathematical performance is investigated in order to determine those aspects of the mathematics curriculum that provide the greatest difficulty for pupils at this age. The results are based upon detailed analysis of the 93 test papers completed by the children during the years 1992, 1993 and 1994. The findings here are question-specific and are compiled in such a way as to provide an indication of achievement in relation to:

- Pupil success rate facility per question (i.e. percentage correct per question)
- the mathematical category concerned, i.e., computation, recall, application and understanding;

For each of the years 1992, 1993 and 1994, the frequency of pupils taking the test is seen in Table 5.12:

Table 5.12 : Frequency of pupils taking the test, 1992 – 1994

	Frequency	Percent
1992	29	31.2
1993	27	29.0
1994	37	39.8
Total	93	100.0

In relation to the gender of the respondents, the number of males is 45 and number of females is 48.

In order to identify those questions that caused pupils the most difficulty, and those that proved the most straightforward, the answers given by each pupil over this three year period were analysed. The numbers of correct/incorrect responses for each item were obtained (see Appendices 11, 12, 13 & 14) and these were then grouped within the mathematical area of computation skills, recall of basic facts, application of concepts and skills, and understanding of basic concepts, as defined within the test instrument. The success rates for each of the 11 questions in the group of computation questions are shown in Table 5.13.

Table 5.13 : Success rates for questions grouped within the Computation skills category

Question	Success Rate	Question	Success Rate
1	82.8%	31	88.2%
8	86.0%	35	82.8%
14	91.4%	36	78.5%
18	88.2%	38	76.3%
27	86.0%	41	65.6%
29	82.8%		

The corresponding success rates for each of the 8 questions within the group of Recall of Basic Facts questions are seen in Table 5.14, while the results relating to these questions within the areas of Application of Concepts and Skills (13 questions) and Understanding of Basic Concepts (18 questions) are shown in Tables 5.15, 5.16 and 5.17 respectively.

Table 5.14 : Success rate for Recall of Basic Facts category

Question	Success Rate	Question	Success Rate
10	81.7%	25	80.6%
12	81.7%	26	79.6%
15	81.7%	37	74.2%
21	82.8%	42	84.9%

Table 5.15 : Success rate for Application of Concepts and Skills category

Question	Success Rate	Question	Success Rate
5	63.4%	24	70.9%
7	64.5%	30	67.7%
11	63.4%	32	66.7%
13	71.0%	33	59.1%
17	67.7%	34	48.4%
19	72.0%	45	43.0%
20	74.2%		

Table 5.16 : Success rate for Understanding of Basic Concepts category

Question	Success Rate	Question	Success Rate
2	67.7%	39	90.3%
3	67.7%	40	86.0%
4	77.4%	42	84.9%
6	79.6%	44	79.6%
9	77.4%	46	78.5%
16	80.6%	47	73.1%
22	79.6%	48	67.7%
23	87.1%	49	63.4%
28	87.1%	50	59.1%

Using the information given in these four tables, it is found that the overall average success rate for each mathematical area is:

Computational Skills	82.6%
Recall of Basic Facts	80.9%
Application of Concepts and Skills	64%
Understanding of Basic Concepts	77%

From this analysis, the mathematical area categorised as Application of Concepts and Skills is seen to be the aspect causing the most difficulty overall, whilst the traditional area of Computational Skills is the one in which the children are most successful.

5.4.2 Difficulties encountered within categories - Gender Differences

A similar analysis to that described in the previous section was undertaken to explore gender differences. Each response was considered in relation to the success rates for both males and females. For example, the results obtained for question 12 are shown in Table 5.17:

Table 5.17 : Success rate for question 12 in terms of gender

Gender * Question 12 Crosstabulation

Count

		Question 12		
		Incorrect answer	Correct answer	Total
Gender	Male	3	42	45
	Female	14	34	48
Total		17	76	93

The question responses in this format were then grouped into the four mathematical areas previously discussed, namely: Computational Skills, Recall of Basic Facts, Application of Concepts and Skills, Understanding of Basic Concepts (see Appendices 15, 16, 17 & 18). This revealed that, in the case of computation (Table 5.18) the boys achieved higher success rates in 9 of the 11 items. The average scores for this section are: boys 85.0% and girls 80.3%.

Table 5.18 : Success rates by gender – Computational Skills

Question	Male Group	Female Group	Question	Male Group	Female Group
1	86.7%	79.2%	31	91.1%	85.4%
8	88.9%	83.3%	35	84.4%	81.3%
14	93.3%	89.6%	36	82.2%	75.0%
18	91.1%	85.4%	38	77.8%	75.0%
27	95.6%	77.1%	41	62.2%	68.8%
29	82.2%	83.3%			

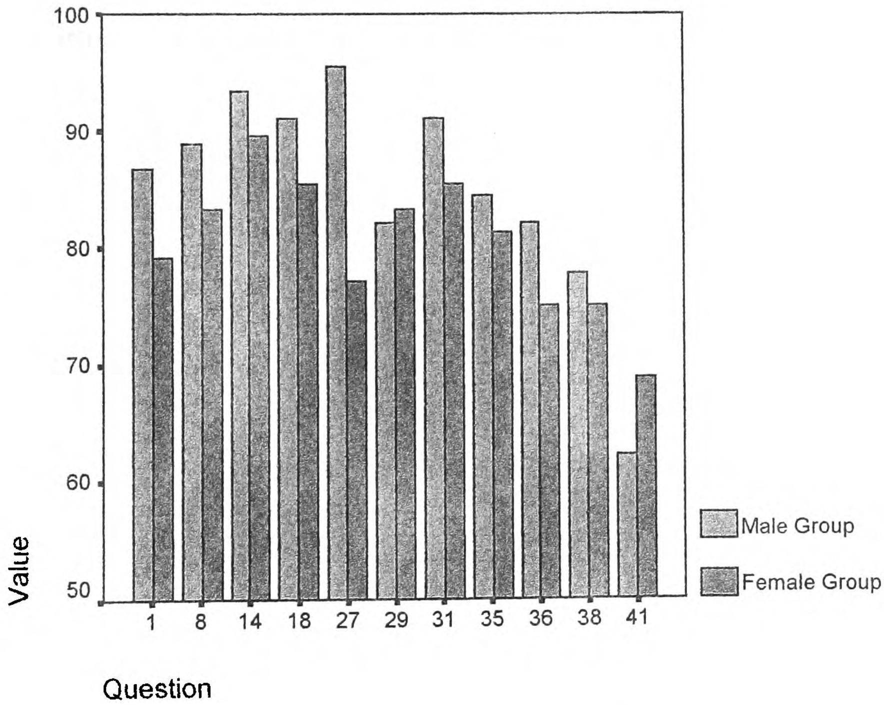

Figure 5.8 : Success rates by gender – Computational Skills

In the area of Recall of Basic Facts, boys achieve higher success rates than girls on 7 of the 8 items. Additionally, the average scores for this section are: boys 86.9%, girls 75.3%.

Table 5.19 : Success rates by gender – Recall of Basic Facts

Question	Male Group	Female Group	Question	Male Group	Female Group
10	95.6%	68.8%	25	86.7%	75.0%
12	93.3%	70.8%	26	80.0%	79.2%
15	86.7%	77.1%	37	77.8%	70.8%
21	91.1%	75.0%	42	84.4%	85.4%

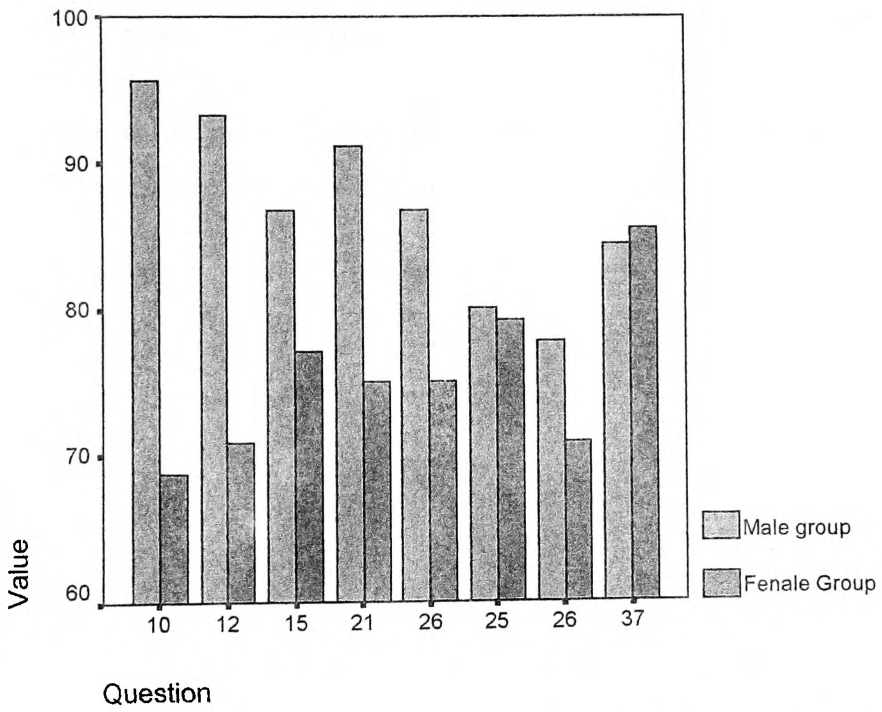

Figure 5.9 : Success rates by gender – Recall of Basic Facts

From Table 5.20 it is seen that boys achieve higher success rates than girls in all 13 items in the section on Application of Concepts and Skills. Average scores are: boys 69.4%, girls 59.2%.

Table 5.20 : Success rates by gender – Application of Concepts and Skills

Question	Male Group	Female Group	Question	Male Group	Female Group
5	66.7%	60.4%	24	77.8%	64.6%
7	68.9%	60.4%	30	71.1%	64.6%
11	68.9%	58.3%	32	71.1%	64.6%
13	82.2%	60.4%	33	68.9%	50.0%
17	73.3%	62.5%	34	55.6%	41.7%
19	73.3%	70.8%	45	46.7%	39.6%
20	77.8%	70.8%			

Significantly, this section on Application is clearly the aspect of mathematics causing the most difficulty for the children within this sample.

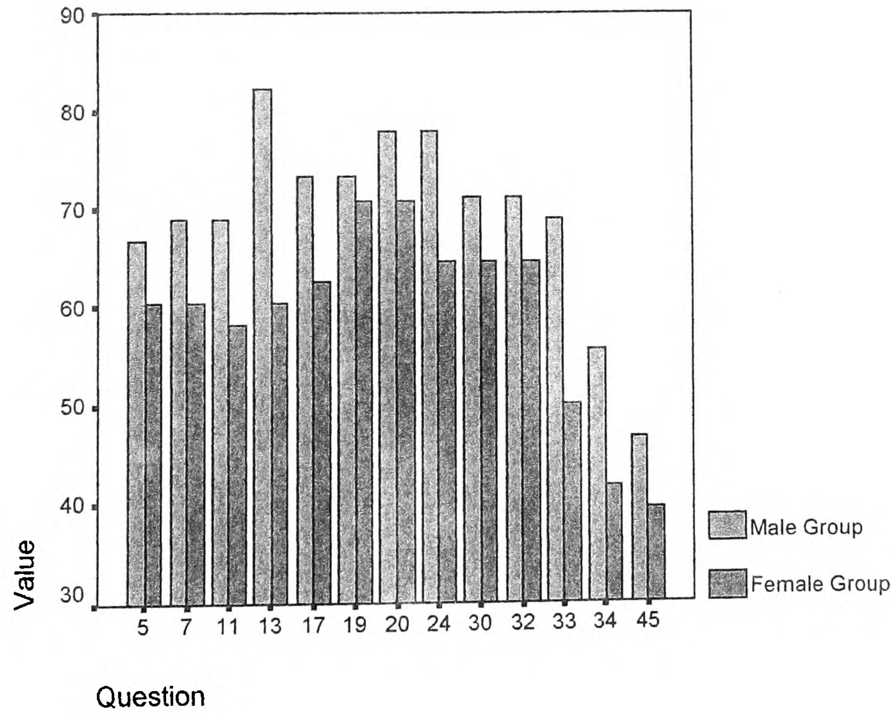

Figure 5.10 : Success rates by gender – Application of Concepts and Skills

As seen in Table 5.21, boys achieve higher success rates in 10 of the 18 items within the Understanding of Basic Concepts section. The averages scores are: boys 81.1%, girls 73.2%.

Table 5.21 : Success rates by gender – Understanding of Basic Concepts

Question	Male Group	Female Group	Question	Male Group	Female Group
2	82.2%	54.2%	39	88.9%	91.2%
3	82.2%	54.2%	40	84.4%	87.5%
4	88.9%	66.7%	42	84.4%	85.4%
6	88.9%	70.8%	44	77.8%	81.3%
9	80.0%	75.0%	46	80.0%	77.1%
16	80.0%	81.3%	47	75.6%	70.8%
22	75.6%	83.3%	48	73.3%	62.5%
23	86.7%	87.5%	49	75.6%	52.1%
28	84.4%	89.6%	50	71.1%	47.9%

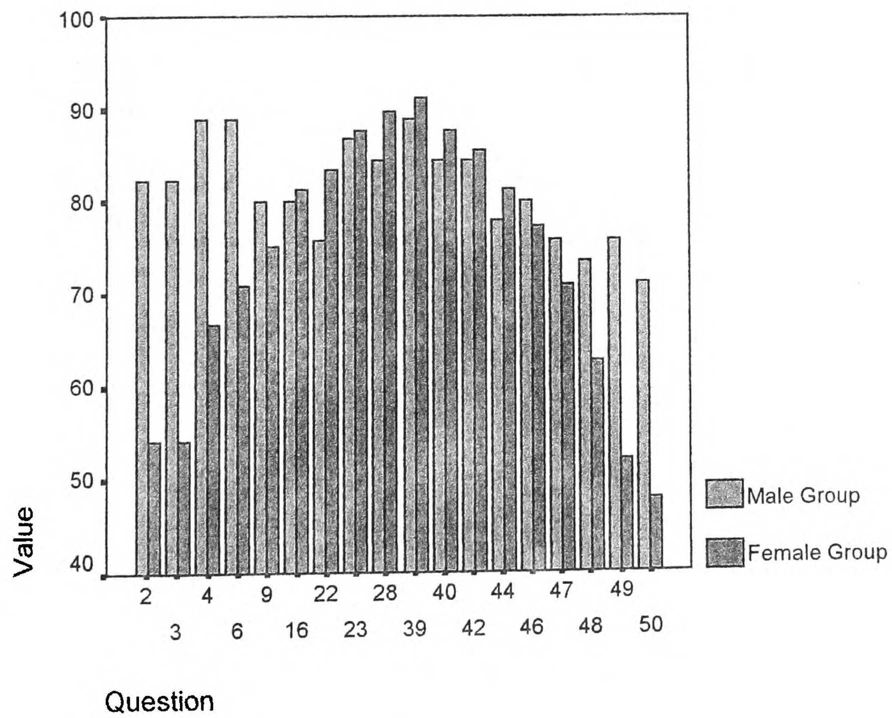

Figure 5.11 : Success rates by gender – Understanding of Basic Concepts

Chi Square tests were undertaken to establish if any significant differences were evident in boys' and girls' performance in each of the four mathematical areas under investigation. The hypotheses tested were:

H_0: There is no significant difference in performance between boys and girls in each of the mathematical areas considered

H_1: There is significant difference in performance between boys and girls in each of the mathematical areas considered

The results of the analysis are shown in Tables 5.22 to 5.25. The entries relate to the number of pupils (boys and girls) obtaining incorrect answers in each of the questions. No significant differences were identified and consequently it was concluded that, on average, boys and girls did not perform differently in any of the four areas.

The t-test was also applied to investigate whether there were any significant differences in the results obtained in the four areas of computation, recall, application and understanding. The hypotheses tested were:

H_0: There is no significant differences in the performance of children within each of the mathematical areas considered.

H_1: There is significant differences in performance of children within each of the mathematical areas considered.

The results are summarised in Table 5.26.

Table 5.22 : Chi Square results for computation

Computation

			COMP											Total
			1.00	2.00	3.00	4.00	5.00	6.00	7.00	8.00	9.00	10.00	11.00	
Gender	Male	Count	0	0	0	1	2	1	1	7	6	13	14	45
		Expected Count	.5	.5	.5	.5	1.0	2.4	2.4	4.8	7.7	12.1	12.6	45.0
	Female	Count	1	1	1	0	0	4	4	3	10	12	12	48
		Expected Count	.5	.5	.5	.5	1.0	2.6	2.6	5.2	8.3	12.9	13.4	48.0
Total		Count	1	1	1	1	2	5	5	10	16	25	26	93
		Expected Count	1.0	1.0	1.0	1.0	2.0	5.0	5.0	10.0	16.0	25.0	26.0	93.0

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	12.310[a]	10	.265
Likelihood Ratio	14.926	10	.135
Linear-by-Linear Association	1.424	1	.233
N of Valid Cases	93		

a. 15 cells (68.2%) have expected count less than 5. The minimum expected count is .48.

Table 5.23 : Chi Square results for recall

Recall

			RECALL							
			2.00	3.00	4.00	5.00	6.00	7.00	8.00	Total
Gender	Male	Count	0	0	1	7	11	15	11	45
		Expected Count	.5	2.4	2.9	7.3	11.1	12.1	8.7	45.0
	Female	Count	1	5	5	8	12	10	7	48
		Expected Count	.5	2.6	3.1	7.7	11.9	12.9	9.3	48.0
Total		Count	1	5	6	15	23	25	18	93
		Expected Count	1.0	5.0	6.0	15.0	23.0	25.0	18.0	93.0

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	10.580[a]	6	.102
Likelihood Ratio	13.145	6	.041
Linear-by-Linear Association	8.758	1	.003
N of Valid Cases	93		

a. 6 cells (42.9%) have expected count less than 5. The minimum expected count is .48.

Table 5.24 : Chi Square results for application

			Application														Total
			.00	1.00	2.00	3.00	4.00	5.00	6.00	7.00	8.00	9.00	10.00	11.00	12.00	13.00	
Gender	Male	Count	0	0	0	1	3	1	4	2	5	7	7	8	4	3	45
		Expected Count	1.0	1.0	.5	.5	3.4	3.4	1.9	3.9	4.8	5.3	7.3	5.3	3.9	2.9	45.0
	Female	Count	2	2	1	0	4	6	0	6	5	4	8	3	4	3	48
		Expected Count	1.0	1.0	.5	.5	3.6	3.6	2.1	4.1	5.2	5.7	7.7	5.7	4.1	3.1	48.0
Total		Count	2	2	1	1	7	7	4	8	10	11	15	11	8	6	93
		Expected Count	2.0	2.0	1.0	1.0	7.0	7.0	4.0	8.0	10.0	11.0	15.0	11.0	8.0	6.0	93.0

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	18.795[a]	13	.130
Likelihood Ratio	23.219	13	.039
Linear-by-Linear Association	4.248	1	.039
N of Valid Cases	93		

a. 21 cells (75.0%) have expected count less than 5. The minimum expected count is .48.

Table 5.25 : Chi Square results for understanding

			Understanding														Total
			4.00	5.00	6.00	7.00	9.00	10.00	11.00	12.00	13.00	14.00	15.00	16.00	17.00	18.00	
Gender	Male	Count	0	0	1	0	0	0	4	4	3	5	11	6	9	2	45
		Expected Count	.5	.5	1.0	.5	.5	1.0	5.3	2.9	2.9	7.3	8.7	6.3	6.8	1.0	45.0
	Female	Count	1	1	1	1	1	2	7	2	3	10	7	7	5	0	48
		Expected Count	.5	.5	1.0	.5	.5	1.0	5.7	3.1	3.1	7.7	9.3	6.7	7.2	1.0	48.0
Total		Count	1	1	2	1	1	2	11	6	6	15	18	13	14	2	93
		Expected Count	1.0	1.0	2.0	1.0	1.0	2.0	11.0	6.0	6.0	15.0	18.0	13.0	14.0	2.0	93.0

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	13.177[a]	13	.434
Likelihood Ratio	16.333	13	.232
Linear-by-Linear Association	5.533	1	.019
N of Valid Cases	93		

a. 18 cells (64.3%) have expected count less than 5. The minimum expected count is .48.

Table 5.26 : Gender differences – t-test summary of categories of question on test instrument

	Gender	N	Mean	Std. Deviation	Std. Error Mean
COMP	Male	45	9.3556	1.7857	.2662
	Female	48	8.8333	2.3640	.3412
RECALL	Male	45	6.6222	1.0931	.1630
	Female	48	5.7292	1.6209	.2340
APPLIC	Male	45	9.0222	2.6067	.3886
	Female	48	7.6667	3.5210	.5082
UNDERST	Male	45	14.6000	2.3875	.3559
	Female	48	13.1875	3.1734	.4580

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
COMP	Equal variances assumed	1.436	.234	1.196	91	.235	.5222	.4367	-.3451	1.3896
	Equal variances not assumed			1.207	87.141	.231	.5222	.4328	-.3379	1.3824
RECALL	Equal variances assumed	6.444	.013	3.094	91	.003	.8931	.2886	.3198	1.4664
	Equal variances not assumed			3.132	82.840	.002	.8931	.2851	.3260	1.4601
APPLIC	Equal variances assumed	4.714	.033	2.099	91	.039	1.3556	.6459	7.263E-02	2.6385
	Equal variances not assumed			2.119	86.456	.037	1.3556	.6397	8.388E-02	2.6272
UNDERST	Equal variances assumed	3.223	.076	2.413	91	.018	1.4125	.5853	.2498	2.5752
	Equal variances not assumed			2.435	87.007	.017	1.4125	.5801	.2596	2.5654

This analysis confirms the conclusion drawn earlier in the case of computational skills. However, it suggests that boys may be significantly better in the areas of recall of basic facts, application of concepts and skills, and understanding of basic concepts, than girls. This is wholly consistent with the pattern of results observed in Tables 5.18 to 5.21 and the overall average success rates quoted.

5.4.3 Difficulties encountered with individual items – gender difference

Further statistical analysis was undertaken to determine if there were any significant differences between boys' and girls' responses to each of the fifty questions. The hypotheses considered were as follows:

H_0: There is no significant difference in scores between genders for each question

H_1: There is significant difference in scores between genders for each question

An example of a typical individual result is seen in Table 5.28 : Chi square result for question 27. The value of 0.01 for Pearson Chi-Square is significant at the 5% level (i.e. < 0.05) so the null hypothesis is rejected, and it is concluded that there is a difference between the performance of boys and girls on this question. From Table 5.27 we see that boys actually outperform girls on this question.

Table 5.27 : Chi square result for question 27

			Question 27		
			Incorrect answer	Correct answer	Total
Gender	Male	Count	2	43	45
		Expected Count	6.3	38.7	45.0
	Female	Count	11	37	48
		Expected Count	6.7	41.3	48.0
Total		Count	13	80	93
		Expected Count	13.0	80.0	93.0

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	6.591[b]	1	.010		
Continuity Correction [a]	5.144	1	.023		
Likelihood Ratio	7.213	1	.007		
Fisher's Exact Test				.015	.010
Linear-by-Linear Association	6.520	1	.011		
N of Valid Cases	93				

a. Computed only for a 2x2 table

b. 0 cells (.0%) have expected count less than 5. The minimum expected count is 6.29.

A similar analysis was undertaken for each question on the test paper. The significant results are summarised in Table 5.28. As can be seen, the null hypothesis is rejected in eleven of the fifty questions considered. This indicates significant differences in scores between boys and girls on 11 of the 50 questions on the instrument. Additionally, as seen from Appendices 15, 16, 17 & 18 respectively, it is confirmed that the boys out perform the girls in all 11 questions.

Table 5.28 : Gender differences – chi-squared summary of significant questions

Question	Area	Chi-Square	Sig.
27	Computation	6.591	.010
10	Factual Recall	11.172	.001
12	Factual Recall	7.871	.005
21	Factual Recall	4.232	.040
13	Application	5.360	.021
2	Understanding	8.366	.004
3	Understanding	8.366	.004
4	Understanding	6.561	.010
6	Understanding	4.658	.031
49	Understanding	5.517	.019
50	Understanding	5.115	.023

5.4.4 Pupil Success Facility in Terms of Number, Measure, Shape and Pictorial Representation

The fifty test items were also grouped in terms of the mathematical topic areas of Number, Measure, Shape and Pictorial Representation (see Table 4.4). The pupil success facilities were calculated and the following results were obtained:

Table 5.29 : Pupil success facilities within the areas of Number, Measure, Shape and Pictorial Representation

	Boys	**Girls**	**Total**
Number	81.30%	73.96%	77.51%
Measure	81.23%	68.29%	74.55%
Shape	80.00%	70.60%	75.15%
Pictorial Representation	73.89%	68.23%	70.97%

Clearly, considering the results in terms of gender, the four areas may be ranked in order of success facility as:

	Boys	**Ranking**	**Girls**	**Ranking**
Number	81.30%	1	73.96%	1
Measure	81.23%	2	68.29%	3
Shape	80.00%	3	70.60%	2
Pictorial Representation	73.89%	4	68.23%	4

Similarly, considering the overall results in terms of pupil success facility, the following ranks occurred:

	Total Score	**Rank**
Number	77.51%	1st
Measure	74.55%	3rd
Shape	75.15%	2nd
Pictorial Representation	70.97%	4th

CHAPTER 6

RESULTS OF THE NATIONAL SURVEY

6.1 INTRODUCTION

In this chapter the results of the national survey undertaken to investigate staff perceptions regarding the current status and implementation of the National Curriculum in Wales are presented. The main aim of this aspect of study is to evaluate teachers' perceptions and opinions relating to changes introduced by the National Curriculum and the perceived effects that these have had upon mathematical achievement of eleven year olds. The questionnaire provided rich quantitative information which gives a picture of teachers' perceptions across Wales.

The results are presented in three sections:

- a description of the characteristics of the sample of respondents incorporating detailed descriptive statistics;
- the general, global findings as they relate to staff perceptions within the eleven areas of the questionnaire;
- further analysis of the national survey questionnaire in relation to specific areas of interest as identified in the research questions.

The first two categories are dealt with in subsequent sections within this Chapter, while the third category is dealt with in Chapter 7, 8 and 9.

6.2 DESCRIPTION OF THE SAMPLE

6.2.1 Overview

This section provides a detailed description of the sample which is constructed on the basis of data collated from Section B of the questionnaire (see Appendix 4). Information was requested on gender, teaching position held within school, academic qualifications, number of mathematics INSET courses attended and number of years teaching experience. Tabulated and cross-referenced data relating to each of these categories is presented in subsequent sections. The characteristics identified will be referred to in Section 6.3 when respondents' views are analysed.

For the purpose of this study the total respondents in the survey were 274 staff out of a possible 420 (65.2% rate of response) from 84 schools within Wales. The questionnaires were sent to the head-teachers of the 84 schools (55 schools participated, a 65.5% rate of response) with a covering letter requesting help to administer them within school. This sample of 84 schools equates to a 5% stratified random sample of Key Stage 2 schools within Wales. Assuming that there is no systematic bias in the responses, it is reasonable to suppose that the respondents answering the questionnaire provide a representative sample of opinions.

The high response rate of 65.2% is attributable to the user friendly design and appearance of the questionnaire, the explicit instructions accompanying it, the concise time-scales involved and the postal arrangements for their return.

6.2.2 Sample According to Position Held in School

The questionnaire requested staff to indicate their current position within school, i.e., teacher, deputy head-teacher or head-teacher. Table 6.1 shows the status of the 274 respondents.

Table 6.1 : Teaching Position held in school

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Teacher	176	64.2	64.2	64.2
	Deputy Headteacher	48	17.5	17.5	81.8
	Headteacher	50	18.2	18.2	100.0
	Total	274	100.0	100.0	
Total		274	100.0		

The 50 head-teachers represent 59.5% of the actual head-teachers invited to participate, while the 48 deputy head-teachers represent 57.1% of those invited. Likewise, the 176 teachers who took part in the survey represented 69.8% of those invited to participate. This indicates a reasonably uniform response rate within the three categories and is judged satisfactory in representing the views of each group.

Additionally, the position held by participants within schools may also be considered in terms of their highest qualifications as shown in Table 6.2:

Table 6.2 : Position in terms of qualifications

	Position			Total
	Teacher	Deputy Headteacher	Headteacher	
Certificate in Education	88	13	14	115
First degree (Bachelor's Degree)	44	27	24	95
Post Graduate Certificate in Education	28			28
Second Degree (Master's Degree)	16	8	12	36
Total	176	48	50	274

6.2.3 Sample According to Gender

Table 6.3 shows the distribution of respondents in terms of gender.

Table 6.3 : Gender of respondents

Gender

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Male	131	47.8	47.8	47.8
	Female	143	52.2	52.2	100.0
	Total	274	100.0	100.0	
Total		274	100.0		

It is seen overall that 131 (47.8%) of the respondents are male while 143 (52.2%) are female. These figures can be subdivided in relation to the position held within the school as shown in Table 6.4.

Table 6.4 : Position held in terms of gender

Position	Male	Female
Teacher	72 (55%)	104 (73%)
Deputy Head-teacher	27 (21%)	21 (15%)
Head-teacher	32 (24%)	18 (12%)

The percentages shown relate to the sub-categories indicated. Consequently it is interesting to note the relatively low proportion of male to female teachers (fifty-five percent to seventy three percent) and to contrast this with the high percentages of male to female head-teachers.

6.2.4 Sample According to Academic Qualifications

This section describes the sample of respondents in relation to their academic qualifications. Question 3, Section B of the questionnaire requested the respondents to indicate the highest qualification they had gained from amongst the following categories:

1. Certificate in Education
2. First Degree (Bachelor's degree)
3. Post Graduate Certificate in Education (P.G.C.E.)
4. Second Degree (Master's degree)
5. Third degree (Doctoral degree)

An overall picture of the highest qualification each respondent holds may be seen in Table 6.5.

Table 6.5 : Highest qualifications of respondents

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Certificate in Education	115	42.0	42.0	42.0
	First degree (Bachelor's Degree)	95	34.7	34.7	76.6
	Post Graduate Certificate in Education	28	10.2	10.2	86.9
	Second Degree (Master's Degree)	36	13.1	13.1	100.0
	Total	274	100.0	100.0	
Total		274	100.0		

Clearly the highest category of qualification is the Certificate in Education (42%) with surprisingly, the Post Graduate Certificate in Education (P.G.C.E.) being held by only 10.2% of respondents. Interestingly, these results, subdivided in terms of gender are shown in Table 6.6. The preponderance of males with higher qualifications goes someway to explaining the gender imbalance amongst deputies and head-teachers illustrated in Table 6.4.

Table 6.6 : Qualifications in terms of gender

Qualification	Male	Female
Certificate in Education	39 (30%)	76(53%)
First Degree	51(39%)	44(31%)
P.G.C.E.	16 (12%)	12 (8%)
Master's Degree	25 (19%)	11 (8%)

6.2.5 Sample according to the Number of Mathematics INSET Courses Attended

Respondents were requested to indicate the number of mathematics in-service courses they had attended and to categorise these according to whether they had attended 0 courses, 1-5 courses, 6-10 courses or 11+ courses. The results are shown in Table 6.7.

Table 6.7 : Number of Mathematics INSET courses attended

INSET courses attended

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0 courses	99	36.1	36.1	36.1
	1 - 5 courses	167	60.9	60.9	97.1
	6 - 10 courses	7	2.6	2.6	99.6
	12	1	.4	.4	100.0
	Total	274	100.0	100.0	
Total		274	100.0		

Additionally, the number of courses attended by respondents may also be considered in relation to number of years teaching experience and gender. These are shown in Tables 6.8 and 6.9 respectively.

Table 6.8 : Mathematics Inset courses attended against years of service

Inset courses attended	0 – 3 years	3 – 7 years	7– 12 years	12 + years
0 courses	6(2.2%)	14(5.1%)	23 (8.4%)	56 (20.4%)
1 – 5 courses	22(8.0%)	17(6.2%)	41(14.9%)	87(31.8%)
6 – 10 courses			3 (1.1%)	4 (1.5%)
12 + courses				1 (0.4%)

Table 6.9 : Courses attended against gender

Inset courses attended	Male	Female
0 courses	53 (40%)	46 (32%)
1 – 5courses	73 (56%)	94 (66%)
6 – 10 courses	5 (4%)	2 (1%)
12 + courses		1 (1%)

6.2.6 Sample according to the Number of years Teaching Experience Gained

Participants were asked to indicate the number of years teaching experience they had gained. Various categories were offered, viz: 0-3 years, 3-7 years, 8-12 years or 12+ years. The information obtained is displayed in Table 6.10:

Table 6.10 : Teaching experience gained by respondents

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid 0.3 years	28	10.2	10.2	10.2
3.7 years	31	11.3	11.3	21.5
8.12 years	67	24.5	24.5	46.0
12+ years	148	54.0	54.0	100.0
Total	274	100.0	100.0	

Additionally, the sample of respondents may be considered in terms of their number of years teaching experience against their gender. This is shown in Table 6.11 where the distribution of each sex is seen to be remarkably similar.

Of particular interest is the group of respondents (i.e. the 27 males and 33 females) who indicated their teaching experience to be less than 7 years. Although these respondents have no direct experience of teaching before the introduction of the National Curriculum the methodology adapted chose to take cognisance of these returns as the research model is based upon current practitioners' perceptions (see page 150). This is a measure of the value the researcher places upon the attitude, experience and opinion of key members of staff who are currently charged with successfully implementing the continuous, ongoing changes within primary schools. Additionally, it recognises the fact that these teachers, regardless of their teaching experiences appear to have no problem in commenting on whether the introduction of the National Curriculum has brought positive or negative benefits. This in itself is an interesting phenomenon and one that warrants further research.

Table 6.11 : Number of years teaching experience against gender

Number of Years teaching experience	Male	Female
0–3 years	14 (11%)	15 (10%)
3–7 years	13 (10%)	18 (13%)
7–12 years	32 (24%)	35 (24%)
More than12 years	72 (55%)	76 (53%)

However, as a result of the decision, clearly a cautionary awareness of this standpoint is required when considering the overall global responses and the associated conclusions made.

6.3 GENERAL FINDINGS

6.3.1 Overview of Section

This section discusses the global responses within the eleven areas (Sections A to K) of the questionnaire. These relate directly to respondents' perceptions of the effects of changes brought about by the introduction of the National Curriculum. The commentary provided addresses each of the research questions identified in Chapter 4, while the tables presented reveal respondents' attitudes and perceptions with regard to each of the categories included in the questionnaire.

For clarity and consistency in analysing the data the 7-point Likert Scale is divided into three sections. This allows the tabulation of the numbers of respondents within the sample who perceived a worsening of each situation, who perceived no change and who perceived an improvement in the situation. Such an approach allows a direct comparison to be made between the numbers of respondents judging a worsening of the situation and those judging an improvement.

The full tabulation of all scores on the 7-point Likert scale is shown in Appendix 19. The mean, median and modal values are also shown in this table for each item. A mean score of more than 4 would indicate the situation for that item was perceived to have improved post introduction of the National Curriculum.

6.3.2 Responses to Section A - Children's Knowledge

> Research Question: *Has the National Curriculum provided benefits in terms of the knowledge gained by pupils?*

Section A of the questionnaire focussed upon children's knowledge. It consisted of twelve questions relating to elements of numeracy and literacy skills that contribute to children's successful achievement within school. Specifically, respondents were asked to judge whether there had been an improvement (or otherwise) in pupils' skills, knowledge and understanding within these key areas. Table 6.12 provides a global summary of the overall distribution of responses. Specific details of the raw and mean scores recorded for this section are seen in Appendix 19, Section A.

Table 6.12 : Global responses to questionnaire item regarding Children's Knowledge

Item (1 of 12 items)	No. perceived worsening of situation	No. perceived no change in situation	No. perceived improvement of situation
q.1. Children's reading skills	94	100	80
q.2. Children's ability to comprehend written passages	96	74	104
q.03. Children's oral skills	50	120	104
q.04. Children's ability to comprehend oral speech	50	136	88
q.5. Children's listening skills	112	102	60
q.6. Children's writing	100	86	88
q.07. Children's ability to perform written commands	84	124	66
q.08. Children's ability in computation	92	90	92
q.09. The ability to problem solve in mathematics	62	70	142
q.10. The quality of knowledge acquired by children	92	70	112
q.11. The quantity of knowledge acquired by children	69	71	134
q.12. The ability to complete investigative tasks	58	58	158

It can be deduced from Table 6.12 that respondents perceive the situation to be largely unchanged or improved in eight of the twelve categories. However, it is alarming that respondents perceive children's reading, listening and writing skills to have worsened (see questions 1, 5 and 6). A perceived worsening of the ability of pupils to perform written commands is also implied (question 7). In relation to mathematical skills, respondents perceive improvement in the key areas of problem solving (51.8%), the quality of knowledge acquired (40.8%), the quantity of knowledge acquired (48.9%) and with the ability to complete investigative tasks (57.6%). Factors associated with this may arise from improved organisation within the classroom in terms of planning, more emphasis on using and applying methods of teaching, and a broader range of mathematics taught within classrooms.

In order to determine whether there is any statistical significance in the differences observed the Chi-square and Wilcoxon tests were applied to the data. This was undertaken for each of the eleven sections. However, the significant results from the Wilcoxon tests are shown in Section A only, as an example of the work undertaken. The remaining sections where the Wilcoxon tests supported the findings of the Chi-square test, these results are noted in the text. The null hypothesis tested was that:

The National Curriculum has had no effect upon Children's Knowledge

Each of the twelve items was tested in turn with Chi-Square analysis, based upon the frequencies reported in Table 6.12. This produced the following outcome and confirmed that the null hypothesis should be accepted in seven of these cases. In the remaining five cases (see Table 6.13) it is necessary to reject the null hypothesis and accept the alternative hypothesis that the National Curriculum has had an effect on children's knowledge.

Table 6.13 : Significant chi-square Results for Children's Knowledge

Item (1 of 12 items)	Worse	Better	Chi-Square	Sig.
q.03. Children's oral skills	50	104	18.935	.000
q.04. Children's ability to comprehend oral speech	50	88	10.464	.001
q.05. Children's listening skills	112	60	15.721	.000
q.11. The quantity of knowledge acquired by children	69	134	20.813	.000
q.12. The ability to complete investigative tasks	58	158	42.296	.000

Clearly from Table 6.13 the general perception is the National Curriculum has had an effect upon aspects of Children's Knowledge as indicated on five of the twelve items in this section rejecting the null hypothesis. Children's listening skills are perceived generally to be deteriorating. However, other key elements identified within Table 6.13 are perceived to be improving, particularly so within key aspects of mathematics education. This is further supported by the results of the Wilcoxon test, which are seen in Table 6.14.

Table 6.14 : Significant Wilcoxon Results for Children's Knowledge

Item (1 of 12 items)	Wilcoxon	Sig.
q.1. Children's reading skills	-2.076	.038
q.03. Children's oral skills	-3.632	.000
q.04. Children's ability to comprehend oral speech	-3.770	.000
q.05. Children's listening skills	-5.591	.000
q.6. Children's writing	-3.278	.001
q.7. Ability to perform written commands	-3.411	.001
q.9. Ability to problem solve in mathematics	-3.552	.000
q.11. The quantity of knowledge acquired by children	-3.902	.000
q.12. The ability to complete investigative tasks	-6.022	.000

6.3.3 Responses to Section B - Children's Affective Domain

Research Question: Has the National Curriculum enhanced schools' overall ethos in relation to developing the affective domain of the pupils?

Section B consisted of questions relating to the development of the child's affective domain. Attitudes and behaviour patterns are an essential ingredient in determining success within school and consequently this is an important area for consideration. Table 6.15 provides a global picture of the distribution of responses to these relevant questions.

Table 6.15 : Global response to questionnaire items regarding Children's Affective Domain

Item (1 of 9 items)	No. perceived worsening of situation	No. perceived no change in situation	No. perceived improvement of situation
q.13. Children's regular attendance	8	222	44
q.14. Children's conduct in school	114	134	26
q.15. Children's respect towards teachers	120	128	26
q.16. Co-operation among children	78	138	58
q.17. Willingness to co-operate with teacher	80	142	52
q.18. Children's sense of responsibility	94	112	68
q.19. Children's interest for learning	84	110	80
q. 20. Children's level of commitment	84	120	70
q.21. Children's willingness to volunteer ideas	42	120	112

Specific details of the raw and mean scores recorded for this section are seen in Appendix 19, Section B.

Clearly with respect to children's regular attendance in school, the majority of respondents perceived the situation as unchanged (81%), with only a very small minority (2.9%) perceiving a worsening of the situation. Only slightly more than 16% believe the situation has improved. This is surprising because H.M.I. throughout the last decade, in conjunction with O.H.M.C.I. in Wales, have focused directly upon rates of attendance within schools. This has resulted in many schools taking positive action to improve attendance rates. For example, patterns of regular absenteeism and lateness of arrival are identified in individuals and channels of communication established between school and home to find the cause of such trends, thereby eliminating all but persistent of offenders. Additionally of course, considerable use is made of umbrella services in education, in this instance, the Education Welfare Officers to improve attendance rates within schools.

The question relating to pupils' conduct in school provides a somewhat surprising result, where 41.6% perceive a worsening situation and 48.9% no change in the situation. Clearly, the greater the amount of time used in dealing with pupil conduct in school results in less direct teaching time available. This undoubtedly would be a contributing factor in an attempt to raise standards within school. Consequently, it is extremely worrying that just over 9% of teachers (or less than 1 in 10) believe that standards of behaviour are improving within the current framework of primary education.

The item on children's respect for teachers resulted in 43.7% of respondents perceiving the situation had worsened. This very disappointing result indicates the respect of many children towards teachers is at a low level. This result however, closely correlates with low levels of parental respect for teachers (see question H61 section 6.3.9). It seems likely that parents' respect towards teachers also influences their children's behaviour regarding this issue. The root cause of such a trend however is very difficult to determine. One factor influencing this is possibly the consistent use of mass media by the Government, reporting upon negative issues emerging from the education system throughout this period of change within schools at the exclusion of the positive issues undertaken.

The issue of co-operation among children indicated participants perceive either no change or an improvement in the situation. However, as the development and promotion of Standard Assessment Tests continues, one must ensure the competition engendered between children does not ultimately reduce the amount of co-operation between children.

Concerning willingness of children to co-operate with teachers, the majority perceived either no change or an improved situation. However, 29.2% of respondents perceived the situation had worsened and this issue must be addressed and improved upon to enable standards of achievement within schools to be improved as the teacher/pupil relationship is a major contributing factor to successful teaching and learning outcomes.

Alarmingly, children's sense of responsibility shows a significant number of respondents, 34.3% perceiving the situation had worsened. When considering the wider aims of primary education, that is, to develop the 'whole person', this result is clearly a cause for concern. Currently, the nature of the National Curriculum, where children are positively encouraged to be active participants in their learning, this perception could result in many children not participating fully in the process and therefore not deriving maximum benefit from the learning environment within the existing framework.

This result however, is further supported by the results of children's interest for learning and, children's level of commitment, where 30.7% and 30.7% respectively, of participants perceived a worsening situation. The results of these questions are interesting, as a key purpose of introducing the National Curriculum was to improve the range and depth of subjects taught within primary schools, therefore via statutory requirements, providing a broad and balanced curriculum for all children within the framework.

However, one must balance this requirement by carefully maintaining the natural curiosity and inquisitiveness of children of this age group in relation to the expectations of the National Curriculum. Clearly, an important balance must be maintained to nurture the genuine and natural interest of children as opposed to stifling this interest as a result of blandly working through a set syllabus or program of study. Such a situation would clearly counter the considerable amount of 'good primary school practice' indicated, for example, in HMI documentation throughout previous years.

In contrast to this, children's willingness to volunteer ideas is very encouraging, with 15.3% perceiving a worsening situation. This attribute within the classroom is essential when currently many teaching methods promote the active participation of children within lessons to their fullest extent, none more so than enabling children to think of and develop their own appropriate strategies for learning and understanding a situation.

In order to determine which of the issues were statistically significant, the Chi-Square and Wilcoxon tests were used. The null hypothesis was of the form:

> ***The National Curriculum has had no effect upon Children's Affective Domain.***

Each of the items, that is, 'children's regular attendance', 'children's conduct in school' etc., were tested in turn with Chi-Square analysis based upon the proportions outlined in Table 6.15 producing the results shown in Table 6.16.

Table 6.16 : Significant Chi-square Result for Children's Affective Domain

Item (1 of 9 items)	Worse	Better	Chi-Square	Sig.
q.13. Children's regular attendance	8	44	24.923	.000
q.14. Children's conduct in school	114	26	55.314	.000
q.15. Children's respect towards teachers	120	26	60.521	.000
q.17. Willingness to co-operate with teacher	80	52	5.939	.015
q.18. Children's sense of responsibility	94	68	4.173	.041
q.21. Children's willingness to volunteer ideas	42	112	31.818	.000

Clearly, from Table 6.16 the general perception was the National Curriculum has had some effect upon Children's Affective Domain, in this instance, on six of the nine items within the section rejecting the null hypothesis. Similarly, the results of the Wilcoxon Tests supported these findings.

6.3.4 Responses to Section C - Teachers' Attitudes in Relation to Staff Morale

> <u>Research Question</u>: *Has the National Curriculum affected staff morale within the teaching profession?*

Section C is based upon teachers' attitudes towards their working practices within school. It consisted of nine questions centred around aspects of teachers' daily routines that are critical to successful learning by pupils within school. Table 6.17 shows the overall distribution of responses in the section.

Table 6.17 : Global responses to questionnaire items regarding Teachers' Attitudes

Item (1 of 9 items)	No. perceived worsening of situation	No. perceived no change in situation	No. perceived improvement of situation
q.22. Teachers' degree of preparation	28	34	212
q.23. Teachers' attention to weak students	38	88	148
q.24. Teachers' attitude towards classroom work	32	92	150
q.25. Teachers' attitude towards homework	14	134	126
q.26. Teachers' attitude towards innovations	86	62	126
q.27. Teachers' attitude towards varying teaching styles	60	92	122
q.28. Teachers attitude towards the importance of pupil assessment	62	72	140
q.29. Teachers' sense of duty	38	134	102
q.30. Teachers' interest in pursuing further studies	130	74	70

Clearly, teachers' degree of preparation, is perceived to have significantly improved with 77.4% indicating this. The fact that such a high proportion of respondents consider the situation had improved seems commensurate with the introduction of precise programs of study which required the detailed planning of classroom practices, preparation of weekly/fortnightly programs and clearly thought-out teaching objectives. In addition to this, the content, teaching methods and assessment procedures all required adaptation, redrafting and implementation, throughout which close scrutiny was constantly placed upon the internal processes of the school from outside sources, for example, through inspections and the associated media reporting of the outcomes of such events.

Additionally, the National Curriculum produced changes in all subjects, particularly in terms of the content of lessons delivered to children and the assessment of associated levels of such content, prescribed within the National Curriculum. Such changes resulted in increased preparation in all subjects within the primary school curriculum. Controversially on this aspect, one has to be extremely aware of the degree to which preparation by staff enabled an improvement in the delivery of subjects within the classroom, and the point at which a very high degree of workload caused disadvantages, for example, absenteeism of staff through illness from stress related scenarios. An obvious disadvantage would be one of discontinuity of teaching staff for children, along with financial disadvantages for the planning and running of the school from supply teacher costs etc.

The issue of teachers' attention to weak students, resulted in 54.7% having perceived an improvement in the situation, which is a marked development. Significantly, the National Curriculum places greater demand upon individual children's progress and improvement, especially from weaker children. Subsequently work within classrooms has been differentiated to match the needs of individuals within subjects. Also of key importance is the increased public and parental awareness of the work undertaken within schools, coupled with the introduction of the notion of more accessibility to school for parents. This precluded the amount of attention given to weaker children within schools in terms of attention focussing upon each individual child's improvement within the entity of a class and, of course, within the whole school environment.

The item of teachers' attitudes towards classroom work is also very positive where 54.8% perceived an improved situation. This may be explained in terms of the direct focus upon classrooms the National Curriculum has produced. Additionally, it is possible that many teachers were more concerned with what was happening in classrooms where the learning environment is almost fully controlled by them rather than directly concerning themselves with issues designed externally to the school or classroom which are beyond their direct and immediate control.

The issue of teachers' attitudes towards homework resulted in the majority having perceived no change or an improved situation. This may be explained in terms of the amount of material that the National Curriculum required to be given to the children. Inevitably this increased the amount of homework set for pupils. Additionally, as the

Standard Assessment Tests were developed for core subjects, more homework may be given to children for preparation and practice for these tests, upon which growing attention is placed as a direct measure of school success, on the primarily Government led issue of raising standards within school.

The issue of the teachers' attitudes towards innovations, resulted in 45.9% having perceived the situation had improved. Although it is felt that many innovations were not properly introduced during this period. For example, everyone concerned within primary education have seen many excellent ideas, methods and processes included within the vast package of proposals. However, two points which are consistently raised relate to the pace and timing of the many innovations and the costs of resourcing such innovations in terms of human and material resources. Often it is such that many of these worthwhile initiatives and innovations were introduced in terms of 'as well as' and 'in addition to', rather than 'instead of', without the additional levels of appropriate funding to support such activities adequately.

The issue of teachers' attitudes towards teaching styles is also perceived to have improved by 44.5% of respondents. This may possibly be explained in terms of the considerable emphasis within schools being placed upon matching the needs of children to subjects, with continual demand for improvement. To facilitate this a review of teaching practices had to be made, particularly, the matching of teaching methods to specific aspects of the curriculum. For example, classroom organisation, children's grouping etc., were changed for different subjects/topics to be taught to ensure maximum benefit for delivering the subject, along with maximising children's opportunity for understanding, consolidating and developing such work.

The item on teachers' attitudes towards the importance of pupil assessment resulted in a positive 51.1% having perceived an improvement in the situation. This single factor has grown in importance considerably as a result of the introduction of the National Curriculum, a key element of which is to improve individual achievement within primary schools. Therefore, assessment was undertaken and refined, particularly in the core subjects, thus by matching children's needs with appropriate levels of work, clearly progress may be made. In addition to these internal needs of schools, increasingly external accountability systems not only require the practice of detailed assessment procedures within schools, they also demand 'evidence' that assessment was being undertaken.

On the item of teachers' sense of duty, significantly 48.9% perceived no change in this aspect. Clearly the teaching profession for many decades has been and is very conscientious in their duty towards the children in their care. Highly questionable therefore, must be Government's persistent attacks upon the integrity of a large proportion of the teaching profession with regard to their sense of duty.

Teachers' interests in pursuing further studies resulted in 47.4% of participants perceiving the situation had worsened. This relates closely to the level of morale expressed by many teaching associations throughout this period. Additionally, issues relating to the amount of preparation would have a considerable impact upon time available for part time study. However, throughout this era, the concept of in-service and staff development training has increased substantially, with many in-service courses being undertaken on an annual basis by a large proportion of teaching staff within primary schools, relating specifically to personal development and school/classroom based priorities.

In order to determine whether there is any statistical significance in the differences observed, the Chi-Square and Wilcoxon tests were applied to the data. The null hypothesis tested was that:

The National Curriculum has had no effect upon Teachers' Attitudes

Each of the nine items was tested in turn with Chi-Square analysis, based upon the frequencies reported in Table 6.18. This confirmed that the null hypothesis should be rejected in all nine cases (see Table 6.19). Total raw and mean scores recorded are seen in Appendix 19, Section C.

Table 6.18 : Significant Chi-Square results for Teachers' Attitudes

Item (1 of 9 items)	Worse	Better	Chi-Square	Sig.
q.22. teachers' degree of preparation	28	212	141.067	.000
q.23. Teachers' attention to weak students	38	148	65.054	.000
q.24. Teachers' attitude towards classroom work	32	150	76.505	.000
q.25. Teachers' attitude towards homework	14	126	89.600	.000
q.26.Teachers' attitudes towards innovations	86	126	7.547	.006
q.27. Teachers' attitude towards varying teaching styles	60	122	21.121	.000
q.28. Teachers' attitude towards the importance of pupil assessment	62	140	30.119	.000
q.29. Teachers' sense of duty	38	102	29.257	.000
q.30. Teachers' interest in pursuing further studies	130	70	18.000	.000

Clearly from Table 6.18 the National Curriculum has had a significant effect upon teachers' attitudes as determined by the null hypothesis being rejected on every item within this section. Results of the Wilcoxon test support these findings.

6.3.5 Responses to Section D - Teachers' Support Mechanisms

> Research Question: *Has the National Curriculum created a climate in which staff may call upon colleagues expertise and experience in the form of support mechanisms for delivering the curriculum?*

Section D is based upon support mechanisms that may be available to staff at the operational level of delivering the curriculum. It consisted of eight questions based upon assistance, guidance and levels of support which are offered to staff in a range of formats within school. Table 6.19 provides the global distributions of responses made by staff.

Table 6.19 : Global Responses to Questionnaire Items Regarding Teachers' Support Mechanisms

Item (1 of 8 items)	No. perceived worsening of situation	No. perceived no change in situation	No. perceived improvement of situation
q.31. Initial level of newly qualified teachers	60	120	94
q.32. Quality of provision of in-service training for teachers	40	62	172
q.33. Head-teachers' guidance on teachers	26	130	118
q.34. The advice offered by other colleagues	2	98	174
q.35. Teachers' knowledge related to quantity of subjects	50	74	150
q.36. Teachers' knowledge related to quantity of subjects	44	92	138
q.37. Teachers' classroom performance	30	104	140
q.38. Subject co-ordinators support for teachers	22	66	186

The raw and mean scores recorded for this section are seen in Appendix 19, Section D. From Table 6.19 perceptions of the initial level of newly qualified teachers resulted in the majority of participants having perceived either no change or an improvement in the situation, certainly a positive perception throughout. The perception of 21.8% of respondents who felt the situation had worsened may be explained by the range and variety of newly qualified teachers entering the profession via a range of different routes. For example, schemes of graduate entry, routes direct from school and mature students. Also of significance are the varying degrees of emphasis different teacher training institutions place upon different elements of training, contributing to a wider and varying baseline of skills from new teachers upon entry to school.

The issue of quality of provision of in-service training for teachers resulted in participants perceiving a very favourable response, where 62.8% indicated improvement in the situation. This may possibly be explained in terms of the quantity and quality of in-service offered. Of particular importance is the introduction of funding allocated to schools specifically for training purposes, that is, GEST funding. Also the introduction and evolving role of the school based inset co-ordinator into the role of staff development officer has made a considerable impact upon planning procedures relating to staff training within school.

The item on head-teachers' guidance to teachers resulted in a favourable perception of the situation. This may be explained in terms of the varying perceived roles of the head-teachers, and the role that they choose to undertake. These roles are clearly variable and differ considerably from school to school. However, most head-teachers would consider supporting their staff, especially throughout the numerous changes, as a key element of their roles of leading their respective staff forward throughout such initiatives.

Considering the advice offered by other colleagues, this resulted in a significant perceived improvement of 63.5% of respondents. Clearly, the introduction of the National Curriculum and its resourcing implications has had a considerable effect upon the process, where many teaching staff utilise resources within schools and a whole new open climate has developed. Also the new inspection framework as used by OHMCI in Wales has increased the number of visitors within schools actively 'seeking' information from within classrooms. Additionally, the developing roles of subject co-ordinators has contributed, where co-ordinators regularly visit colleagues classrooms monitoring their subject. This has led to a more open, less defensive atmosphere within schools, resulting in the emergence of considerably more professional discussion within schools, thereby setting up channels of supportive and constructive advice being offered between colleagues of differing areas of expertise.

The issue of teachers' knowledge related to quantity of subjects and teachers knowledge related to quality of teaching required both yielded very positive results. That is, 54.7% and 50.4% respectively, of respondents perceived the situation has improved. A major focus of the National Curriculum is to establish a curriculum that is broad and balanced. Therefore the compulsory teaching of the core and foundation subjects increased for many teachers the range and depth of subjects taught within primary schools. Additionally, the nationally led focus upon raising standards has led to increased self monitoring, evaluation and review of performance in relation to quality of lessons taught. This, in addition to demands of inspection procedures, has led to increased awareness of the quality of teaching required throughout.

Teachers' classroom performance clearly resulted in 51.1% of respondents having perceived an improvement in the situation. This favourable result may possibly be explained in terms of the amount of preparation, planning and organisation demanded for the implementation of the national curriculum, which undoubtedly had a drastic effect upon teachers' classroom performance within the context of individual classrooms, and of course throughout the whole school situation. Certainly, improved organisation would contribute to more confidence and dynamism shown within classrooms.

The item of subject co-ordinators support of teachers resulted in 67.8% of respondents having perceived the situation has improved. This significant result clearly indicates that the role of the subject co-ordinators within primary schools is perceived to have grown considerably. This role not only involves resourcing the organised scheme of work or syllabus, but has developed to the point where monitoring, evaluation and review of the subject throughout the whole school is an essential function. Additionally, the element of identifying staff training needs to maintain the eventual realisation of set targets has also increased the specification of subject co-ordinators' roles. For example, particularly so in developing an increased awareness of activities, issues and trends within their subject which are determined and driven externally to the school situation.

In order to determine which of the issues were statistically significant the Chi-Square and Wilcoxon tests were used. Once again the null hypothesis was of the form:

The National Curriculum has had no effect upon Teachers' support Mechanism.

Each of the eight items was tested in turn with Chi-Square analysis, based upon the frequencies reported in Table 6.19. This confirmed that the null hypothesis should be rejected in all eight cases (see Table 6.20).

Table 6.20 : Significant Chi-Square result for Teacher's Support Mechanisms

Item (1 of 8 items)	Worse	Better	Chi-Square	Sig.
q.31. Initial level of newly qualified teachers	60	94	7.506	.006
q.32.Quality of provision of in-service training for teachers	40	172	82.189	.000
q.33. Head-teachers' guidance on teachers	26	118	58.778	.000
q.34. The advice offered by other colleagues	2	174	168.091	.000
q.35. Teacher's knowledge related to quantity of subjects	50	150	50.000	.000
q.36. Teachers' knowledge related to quantity of subjects	44	138	48.549	.000
q.37. Teachers' classroom performance	30	140	71.176	.000
q.38. Subject co-ordinators support for teachers	22	186	129.308	.000

Significantly, Table 6.20 illustrates the fact that the National Curriculum has had a major effect upon teachers' Support Mechanisms within schools with the null hypothesis rejected in all eight items within this section. This is supported by the results of the Wilcoxon test.

6.3.6 Responses to Section E - Objectives/Outcomes

Research Question: Has the National Curriculum provided clarity in terms of the objectives and outcomes schools are able to set for their mathematics teaching?

Section E is based upon objectives/outcomes set within school. It consisted of six questions relating to issues of organisation, the dispersion of responses may be seen in Table 6.21.

Table 6.21 : Global responses to questionnaire items regarding Objectives/Outcomes

Item (1 of 6 items)	No. perceived worsening of situation	No. perceived no change in situation	No. perceived improvement of situation
q. 39. Clarity of your schools objectives in mathematics	2	56	216
q.40. Clarity of your school's outcomes in mathematics	14	62	198
q.41. Clarity of objectives in mathematics	6	52	216
q.42. Clarity of your curriculum outcomes in mathematics	10	54	210
q.43. The clarity of your objectives in teaching	10	54	210
q.44. The presence of objectives in all aims	6	48	220

Full responses in terms of raw and mean scores recorded are seen in Appendix 19, Section E.

This section relates directly to organisation within the school and classroom. Clearly, all responses to this section were very positive, all of them being significant in terms of the perceptions of participants indicating considerable improvement in the situation. These elements are key aspects in all schools, which will ultimately determine and ensure the successful organisation and delivery of the curriculum.

The very nature of a National Curriculum brings together planned intentions, various forms of organisation, along with various teaching methodologies used to deliver the intended lesson content. From responses indicated in Table 6.21, this appears to have been achieved very successfully. The overall response illustrates a significant improvement in terms of individuals being made fully aware of what is expected of them within the National Curriculum framework and the clarity of focus within the school towards its set goals.

In order to determine whether there is any statistical significance in the differences observed, the Chi-Square and Wilcoxon tests were applied to the data. The null hypothesis was that:

The National Curriculum has had no effect upon objectives/ outcomes

Each of the six items was tested in turn with Chi-Square analysis, based upon the frequencies reported in Table 6.21. This confirmed that the null hypothesis should be rejected in all six of these cases (see Table 6.22).

Table 6.22 : Significant Chi-square Results for Objectives/Outcomes

Item (1 of 6 items)	**Worse**	**Better**	**Chi-square**	**Sig.**
q. 39. Clarity of your schools objectives in mathematics	2	216	260.073	.000
q.40. Clarity of your school's outcomes in mathematics	14	198	159.698	.000
q.41. Clarity of objectives in mathematics	6	216	198.649	.000
q.42. Clarity of your curriculum outcomes in mathematics	10	210	181.818	.000
q.43. The clarity of your objectives in teaching	10	210	181.818	.000
q.44. The presence of objectives in all aims	6	220	202.637	.000

Clearly, from Table 6.22, the National Curriculum has been perceived as having a significant effect upon the objectives/outcomes within school, as indicated in all six items within this section rejecting the null hypothesis. Similarly, the Wilcoxon test results support these findings.

6.3.7 Responses to Section F - Curriculum Content

<u>Research Question</u>: *In relation to the content of the mathematics syllabus, does the National Curriculum provide a viable curriculum?*

Table 6.23 reports the dispersion of perceptions of each respondent with regard to Section F, relating to aspects of curriculum content.

Table 6.23 : Global responses to questionnaire items regarding Curriculum Content

Item (1 of 7 items)	No. perceived worsening of situation	No. perceived no change in situation	No. perceived improvement of situation
Q.45. The quantity of mathematics taught by you	34	92	148
q.46. The standard of mathematics throughout Key Stage 2	62	96	116
q.47. Time which is allotted to teaching mathematics	70	94	110
q.48. The quality of new textbooks published on mathematics	14	58	202
q.49 The variety of textbooks used by you in teaching of mathematics	12	90	172
q. 50. The content of mathematics textbooks used in your classroom	18	62	194
q. 51. The general presentation of mathematics textbooks used by you	12	46	216

The raw and mean scores recorded for this section are seen in Appendix 19, Section F.

Clearly from the above the issue of the quantity of mathematics taught, resulted in a perceived improvement in the situation by 54% of respondents. This result may be explained not only in terms of the considered importance of mathematics being increased, but rather, in terms of the focus placed upon mathematics, as one of the three core subjects within the National Curriculum framework. This focus is further enhanced by mathematics being one of the three subjects which is vigorously tested and examined by the end of the Key Stage Standard Assessment Tests. This has undoubtedly resulted in a broader quantity of mathematics being taught within primary schools, with more emphasis placed upon individual children undertaking such activities.

The standard of mathematics throughout Key Stage 2 is perceived by 42.3% of respondents to have improved. This perceived improvement is possibly the result of the National Curriculum broadening out the range and depth of mathematics taught within primary schools. Additionally, the curriculum is viewed more so in terms of enabling children to develop a fuller, deeper understanding of topics as opposed to compartmentalising them, ignoring any possibility if inter-relationships between the concepts being developed and enhanced.

Time that is allotted to teaching mathematics results in 40.1% perceiving an improvement in the situation. This reflects the possibility that more direct time is allotted to teaching mathematics as a direct result of restructuring the whole of the primary schools curriculum, enabling the allocation of appropriate amounts of time to all subjects to enable the delivery of the statutory elements of the curriculum.

This section, relating to the use of textbooks in the teaching and delivery of the mathematics curriculum, indicates respondents perceived a significant improvement in this aspect. These results are further supported by findings in Section I (Mathematical Textbooks), where this key factor is further investigated.

In order to determine which of the issues were statistically significant, the Chi-Square and Wilcoxon tests were used. The null hypothesis was of the form:

The National Curriculum has had no effect upon Curriculum Content

Each of the seven items was tested in turn with Chi-Square analysis, based upon the frequencies reported in Table 6.23. This confirmed that the null hypothesis should be rejected in all seven of these cases (see Table 6.24).

Table 6.24 : Significant Chi-square results for Curriculum Content

Item (1 of 7 items)	Worse	Better	Chi-Square	Sig.
Q.45. The quantity of mathematics taught by you	34	148	76.407	.000
q.46. The standard of mathematics throughout Key Stage 2	62	116	16.382	.000
q.47. Time allotted to teaching mathematics	70	110	8.889	.003
q.48. The quality of new textbooks published on mathematics	14	202	163.630	.000
q.49. The variety of textbooks used by you in your teaching	12	172	138.130	.000
q. 50. The content of mathematics textbooks used in your classroom	18	194	146.113	.000
q. 51. The general presentation of mathematics textbooks used by you	12	216	182.526	.000

Table 6.24 emphasises the view that the National Curriculum has had a significant effect upon curriculum content within schools. The Wilcoxon test supported these findings.

6.3.8 Responses to Section G - Curriculum Methodology

> <u>*Research Question*</u>*: Has the National Curriculum provided a catalyst for the development and refinement of curriculum methodology?*

Section G is based upon Curriculum Methodology. It consisted of eight questions that focus upon aspects contributing to the successful delivery of the curriculum. Table 6.25 reports the results of each respondent on this section.

Table 6.25 : Global responses to questionnaire items regarding Curriculum Methodology

Item (1 of 8 items)	No. perceived worsening of situation	No. perceived no change in situation	No. perceived improvement of situation
q.52. Your use of teaching aids	6	126	142
q.53. Matching of mathematics taught with children's ability level	16	106	152
q.54. Atmosphere in classrooms to enable learning	46	128	100
q.55. Appropriateness of classroom organisation	16	136	122
q.56. Information given to teachers about innovations	32	104	138
q.57. The introduction of new methods within your classroom	28	114	132
q.58. Teachers attitude towards the introduction of new methods	42	98	134
q.59. Methodological recommendations offered in mathematical texts	32	114	128

Raw and mean scores recorded for this section are seen in Appendix 19, Section G. Clearly from Table 6.25 respondents for this section perceive the situation has improved overall. This favourable response is a key factor towards the success of the innovation, for as diverse as the national curriculum is, staff within schools have clearly considered and employed strategies and methodologies, not singularly to deliver the curriculum, but additionally to deliver the curriculum in a real, meaningful way which is fully comprehended by the children. Clearly from these findings many staff have taken the opportunity and used the introduction of the National Curriculum positively and diversified curriculum methodologies appropriately to encompass the various elements of the curriculum to improve the overall generic methodologies used within the school curriculum for delivery of the statutory elements of the curriculum.

In order to determine whether there is any statistical significance in the differences observed the Chi-Square and Wilcoxon tests were applied to the data. The null hypothesis tested was that:

The National Curriculum has had no effect upon Curriculum Methodology

Each of the eight items was tested in turn, with Chi-Square analysis based upon the frequencies reported in Table 6.25. This confirmed that the null hypothesis should be rejected in all eight cases (see Table 6.26).

Table 6.26 : Significant Chi-square Results for School/Community Relations

Item (1 of 8 items)	Worse	Better	Chi-Square	Sig.
q.52. your use of teaching aids	6	142	124.973	.000
q.53. Matching of the mathematics taught with the children's ability	16	152	110.095	.000
q.54. Atmosphere in classrooms to enable learning	46	100	19.973	.000
q.55. Appropriateness of classroom organisation	16	122	81.420	.000
q.56. Information given to teachers about innovations	32	138	66.094	.000
q.57. The introduction of new methods within your classroom	28	132	67.600	.000
q.58. Teachers' attitudes towards the introduction of new methods	42	134	48.091	.000
q.59. Methodological recommendations offered in textbooks	32	128	57.600	.000

Clearly respondents perceived the National Curriculum has had an effect upon curriculum methodology. Further, the Wilcoxon test results substantiate this fact.

6.3.9 Responses to Section H - School - Community

> Research Question: *Has the National Curriculum provided benefits in terms of improved relationships between the school and the wider external community?*

Table 6.27 reports the responses made concerning staff attitudes towards aspects of the school interacting with elements of the community. Section H consisted of 5 questions.

Table 6.27 : Global responses to Questionnaire Items Regarding School/Community Relations

Item (1 of 5 items)	No. perceived worsening of situation	No. perceived no change in situation	No. perceived improvement of situation
q. 60. Relations between teachers and parents	22	150	102
q.61. Parents' respect for teachers	158	76	40
q.62. The co-operation of the community with the school	52	136	86
q.63. Community's respect for school	94	124	56
q.64. The influence of school within the community	68	148	58

Raw and mean scores recorded for this section are seen in Appendix 19, Section H. From Table 6.27 it is seen generally the overall responses indicated a perception of no change/improvement in the situation. However, significantly within this section is the result for parents' respect for teachers which is perceived to have significantly worsened, with 57.7% indicating this. This clearly is a cause for concern as this could affect many children's attitude and behaviour within school to a detrimental effect. Ultimately, such negative trends will need to be reversed for improvement in standards generally, and children individually will only materialise with the enhanced and sustained co-operation and support between the school and the home.

In order to determine which of the issues were statistically significant the Chi-Square and Wilcoxon tests were used. Once again the null hypothesis was of the form:

> ***The National Curriculum has had no effect upon school/ community relation.***

Each of the five items was tested in turn with Chi-Square analysis, based upon the frequencies reported in Table 6.27. This confirmed that the null hypothesis should be accepted in one of the cases. In the remaining four case (see Table 6.28) it is necessary to reject the null hypothesis.

Table 6.28 : Significant Chi-square Results for School/Community Relations

Item (1 of 5 items)	Worse	Better	Chi-Square	Sig.
q.60. Relations between teachers and parents	22	102	51.613	.000
q.61. Parents' respect for teachers	158	40	70.323	.000
q.62. The co-operation of the community with the school	52	86	8.377	.004
q.63. Community's respect for school	94	56	9.627	.002

As seen from Table 6.28, on four of the five items within this section respondents perceived that the National Curriculum has had an effect upon school/community relations. These results are further supported by the results of the Wilcoxon tests.

6.3.10 Responses to Section I - Mathematical Textbooks

> Research Question: *Has the National Curriculum initiated development and improvements in relation to mathematical textbooks available for delivering the subject?*

Section I consisted of twelve questions relating to the use of mathematical textbooks within the curriculum. The overall distribution of responses is seen in Table 6.29.

Table 6.29 : Global Responses to Questionnaire Items Regarding Mathematical Textbooks

Item (1 of 12 items)	No. perceived worsening of situation	No. perceived no change in situation	No. perceived improvement of situation
q.65.The quality of graphs, pictures tables and diagrams you use	4	94	176
q.66. The number of tasks provided for children to solve	22	94	158
q.67. Are too abstract for the children's age they are produced for	54	162	58
q.68. Provides a content that meets the children's needs	48	138	88
q.69. Restricts my teaching methods	44	178	52
q.70. Present mathematical content accurately	28	168	78
q.71. Do not follow the logical sequence of the subject	78	120	76
q.72. Are adequate for children's self study	70	138	66
q.73. Present examples, activities and exercises relevant to the children's experience	62	122	90
q.74. Greatly assist me in lesson preparation	54	92	128
q.75. Do not include material in the form of motivation or enrichment topics	54	132	88
q. 76. Are accompanied by Teachers' Manuals I use regularly	16	120	138

Appendix 19, Section I, shows the raw and mean scores recorded for this section. It is seen from Table 6.29 that respondents perceived a considerable improvement in the use of mathematical textbooks in the teaching of mathematics. Clearly this is a two-way relationship, where if the quality, content, and general usage of the material is of assistance in meeting the needs of the schemes of work and syllabus, this is a considerable advantage for teachers. Additionally of course, if the producers of such material provide quality materials and are considered to be appropriate for use within this sector of education and are purchased by schools to support their teaching programs, the rewards are extremely lucrative. However, the use of such material must be clearly defined and understood to ensure its optimum use.

Such use would essentially depend upon two factors within a given school. That is, the organisation of mathematics within the school and the expertise of individual members of staff in teaching of mathematics within the National Curriculum framework.

Organisation of mathematics within and throughout a school will determine the use of textbooks as either a support and supplement mechanism to a set syllabus or program of study pre-planned within the school or, and quite inappropriately, in place of and instead of an organised syllabus for staff to work through.

Use of textbooks relating to staff expertise in mathematics focuses specifically upon levels of competencies of individual staff. If for example, quite legitimately an individuals expertise lies outside of mathematics, staff may use such textbooks and materials to support and assist them in the delivery of the school mathematics syllabus. Obviously, within a supportive role one would be aware of and avoid over dependence on such materials, at the expense of delivering the mathematics syllabus of the school successfully and appropriately to the children.

In order to determine whether there is any statistical significance in the differences observed the Chi-Square and Wilcoxon tests were applied to the data. The null hypothesis tested was that:

> ***The National Curriculum has had no effect upon mathematical textbooks produced***

Each of the twelve items was tested in turn with Chi-Square analysis, based upon the frequencies reported in Table 6.29. This confirmed that the null hypothesis should be accepted in four of these cases. In the remaining eight cases (see Table 6.30) it is necessary to reject the null hypothesis.

Table 6.30 : Significant Chi-square result for Mathematical Textbooks

Item (1 of 12 items)	Worse	Better	Chi-Square	Sig.
q.65. Quality of graphs, pictures tables & diagrams used	4	176	164.356	.000
q.66. The number of tasks provided for children to solve	22	158	102.756	.000
q.68. Provides a content that meets the children's needs	48	88	11.765	.001
q. 70. Present mathematical content accurately	28	78	23.585	.000
q.73. Present examples, activities and exercises relevant to the children's experience	62	90	5.158	.023
q.74. Greatly assist me in lesson prep.	54	128	30.088	.000
q. 75. Do not include material in the form of motivation or enrichment topics	54	88	8.141	.004
q.76. Are accompanied by teachers' manuals I use regularly	16	138	96.649	.000

Clearly from Table 6.30, with the exception of four of the twelve items, respondents perceive the National Curriculum has had an effect upon the usage of mathematical textbooks produced for schools and rejected the null hypothesis on eight items. These results are further supported by the Wilcoxon test.

6.3.11 Responses to Section J - Proportion of time/Emphasis

> Research Question: *Has the National Curriculum provided clarity in relation to the adoption of specific subject teaching methodologies within schools?*

Section J, consisted of questions relating to mathematics teaching styles within schools. Table 6.30 reported the overall dispersion of perceptions of respondents to this section.

Table 6.31 : Global Responses to Questionnaire Items Regarding Proportion of Time/Emphasis

Item (1 of 10 items)	No. perceived worsening of situation	No. perceived no change in situation	No. perceived improvement of situation
q.77. Lecture Method	30	154	90
q.78. Demonstration/ illustration	18	126	130
q. 79. Discussion	20	108	146
q.80. Drill and Practice	50	116	108
q.81. Problem Solving	40	72	162
q.82. Discovery Approaches	84	64	126
q.83. The expository Style	20	132	122
q.84. Investigational work	26	50	198
q.85. Practical Activity	28	72	174
q.86. Programmed learning	42	136	96

The full raw and mean scores recorded for this section are seen in Appendix 19, Section J. From the results within Table 6.31, it appears that every aspect of methodology is perceived as having improved during this period in terms of the proportion of time and emphasis placed upon the methods used to teach mathematics. Possibly this may be explained in terms of the curriculum being increasingly focused upon and organised in such detail as to identify and use specific methods of teaching, in relation to specific aspects of the curriculum to be delivered. In particular, areas of problem solving, investigational work and practical activity, are perceived to have significantly improved. This may be attributable to the aim of enabling children to fully understand and use the knowledge and skills taught in real activities to solve and investigate realistic, meaningful problems.

In order to determine which of the issues were statistically significant the Chi-Square and Wilcoxon tests were used. The null hypothesis was of the form:

> ***The National Curriculum has had no effect upon proportion/ emphasis of teaching time***

Each of the ten items was tested in turn with Chi-Square analysis, based upon the frequencies reported in Table 6.31. This confirmed that the null hypothesis should be rejected in all ten cases (see Table 6.32).

Table 6.32 : Significant Chi-square Results for Proportion of/Emphasis on Teaching Time

Item (1 of 10 items)	Worse	Better	Chi-Square	Sig
q.77. Lecture Method	30	90	30.000	.000
q.78. Demonstration/ illustration	18	130	84.757	.000
q. 79. Discussion	20	146	95.639	.000
q.80. Drill and Practice	50	108	21.291	.000
q.81. Problem Solving	40	162	73.683	.000
q.82. Discovery Approaches	84	126	8.400	.004
q.83. The expository Style	20	122	73.268	.000
q.84. Investigational work	26	198	132.071	.000
q.85. Practical Activity	28	174	105.525	.000
q.86. Programmed learning	42	96	21.130	.000

From Table 6.32 results indicate respondents perceive significantly the National Curriculum has had an effect upon the use and proportion of /emphasis on teaching time used within schools and the null hypothesis has been rejected on all ten items within this section. Similarly, the Wilcoxon test results support these findings.

6.3.12 Responses to Section K - General Question

> <u>Research Question</u>: *Has the National Curriculum improved the chances of raising standards in primary education?*

Section K consisted of a general question based upon changes introduced by the National Curriculum and its effect upon the curriculum. Table 6.33 reports the views of respondents to this question.

Table 6.33 : Global Responses to Questionnaire Items Regarding General Question

Item (1 of 1 items)	No. perceived worsening of situation	No. perceived no change in situation	No. perceived improvement of situation
q.87. NC improved chances of raising standards	106	36	132

Raw and mean scores recorded for this section are seen in Appendix 19, Section K. This question received a broad range of responses from participants. However, the majority perceive the affect of introducing the National Curriculum and the chances of raising standards in primary education has remained the same (13.1%), or significantly improved (48.1%). Perceptions and especially positive attitudes of this nature, are critically important for the long term success of the National Curriculum. It is staff such as those surveyed who are charged with the duty of delivering the curriculum within schools, and ultimately it is their performance that will determine whether overall standards are to improve, and whether this major innovation within the UK education system is successful.

In order to determine whether there are any statistical significance in the differences observed the Chi-Square and Wilcoxon tests were applied to the data. The null hypothesis tested was that:

> ***The National Curriculum has had no effect upon the chances of raising standards in primary schools.***

Chi-Square analysis based upon the frequencies reported in Table 6.33 produced the following outcome:

Table 6.34 : Chi-square Result for General Question

Item (1 of 1 item)	Worse	Better	Chi-Square	Sig.
q.87. Has introduction of the NC improved/ worsened chances of raising standards	106	132	2.840	.092

Clearly from Table 6.34 the general perception of the National Curriculum having had an effect upon the chances of raising standards in primary schools, the null hypothesis is accepted on this item.

6.4 FURTHER ANALYSIS

Further analysis of the survey data will be undertaken in the next three chapters. This analysis relates specifically to the research questions identified in Chapter 4, section 4.3.2. These are investigated to determine whether differences in perception exist within the sample in the context of the independent variable identified within Section B of the questionnaire, namely:

1. position held within school;
2. gender;
3. qualifications;
4. number of mathematics in-service courses attended;
5. number of years teaching experience.

The presentation of findings is within three categories. The general strategy is to report statistically significant differences between groups of respondents within the eleven key topic areas the dependent variables addressed in the questionnaire, that is:

- children's knowledge;
- children's affective domain;
- teachers attitudes;
- teachers' support mechanisms;

- objectives/outcomes;
- curriculum content;
- curriculum methodology;
- school – community;
- mathematical textbooks;
- methods of teaching;
- general question.

When considering the null hypotheses, the Mann-Whitney test with a significance level of 0.05 is used. This means that the probability of rejecting the null hypothesis when it is in fact correct (a type 1 error), is less than 0.05.

Resulting from the enormity of this task, the research questions are considered in terms of three distinct categories, that is,

- role-related factors;
- person-related factors;
- qualification-related factors.

Each of these categories is dealt with in a separate chapter.

With reference to the role-related factors it is of importance to establish if there are significant differences in the perceptions and attitudes of staff between three key positions held within school, that is, head-teachers, deputy head-teachers and teachers. Clearly, all three positions have quite distinct and separate roles in determining the success of the National Curriculum within schools. Analysis is undertaken of role-related factors in respect of the eleven sections within the research questionnaire in Chapter 7.

Person-related issues are considered in Chapter 8, and are based upon the perceptions and attitudes of respondents according to their gender, and also in relation to the number of years teaching experience they have gained. It is intended to investigate whether these variables have any identifiable influence on the perceptions of staff who are involved directly with the process of implementing and delivering the National Curriculum mathematics syllabus within schools.

Specific groupings in terms of number of years teaching will be considered in the following categories:

- 0– 3 years against 8 – 12 years;
- 3 – 7 years against 8 – 12 years;
- 3 – 7 years against 12 years +;
- – 12 years against 12 years +.

It is also of interest to establish if there are any significant differences in the perceptions of staff within schools in relation to the qualifications held, and the number of in-service mathematics courses attended throughout their career. These matters are considered in Chapter 9.

CHAPTER 7

COMPARATIVE ANALYSIS BASED UPON ROLE RELATED FACTORS

7.1 INTRODUCTION

In this chapter the perceptions of teachers, deputy head-teachers and head-teachers are compared. Each of the research questions investigated in Chapter 6 is re-visited and the corresponding null hypothesis tested for differences between pair-wise groups. In order to aid clarity the relevant research questions are reproduced as subheadings. In each the null hypothesis is implicit and reinforced in Chapter 6. As stated earlier the tabulations show only significant results.

7.2 SECTION A – CHILDREN'S KNOWLEDGE

> *Research Question: Has the National Curriculum provided benefits in terms of the knowledge gained by pupils?*

From Table 7.1 it can be deduced that the null hypothesis is accepted in seven of the twelve items in this section within the grouping of teacher against head-teacher. This indicates that no differences in perception exist between head teachers and teachers on issues of:

(a) reading skills;

(b) ability to comprehend written passages;

(c) ability to comprehend oral speech;

(d) ability to perform written commands;

(e) ability in computation;

(f) ability to problem solve in mathematics;

(g) ability to complete investigative tasks;

Table 7.1 Perceptions of head-teachers and teachers on children's knowledge

Item (1 of 12 items)	Group	N	Mean Rank	Sum of Ranks	Mann-Whitney	Sig.
q.03. Children's oral skills	Teacher	176	108.63	19118.00	3542.000	.027
	Head-teacher	50	130.66	6533.00	3542.000	.027
q.5. Children's listening skills	Teacher	176	108.84	19156.00	3580.000	.036
	Head-teacher	50	129.90	6495.00	3580.000	.036
q.6. Children's writing	Teacher	176	108.65	19122.00	3546.000	.030
	Head-teacher	50	130.58	6529.00	3546.000	.030
q.10. The quality of knowledge acquired by children	Teacher	176	107.59	18936.00	3360.000	.009
	Head-teacher	50	134.30	6715.00	3360.000	.009
q.11. The quantity of knowledge acquired by children	Teacher	176	108.13	19030.00	3454.000	.016
	Head-teacher	50	132.42	6621.00	3454.000	.016

Similarly, the null hypothesis is accepted in nine of the twelve items within the grouping of deputy head-teacher against head-teacher. No differences exist on issues of children's:

(a) reading skills;
(b) ability to comprehend written passages;
(c) oral skills;
(d) listening skills;
(e) ability in computation;
(f) ability to problem solve in mathematics;
(g) quantity of knowledge acquired;
(h) ability to complete investigative tasks.

Likewise, the null hypothesis is accepted in nine of the twelve items in this section within the grouping of teacher against deputy head-teacher. No differences in perception occur on the issues of children's:

(a) reading skills;
(b) ability to comprehend written passages;
(c) oral skills;
(d) writing;
(e) ability in computation;
(f) ability to perform written commands;
(g) ability to problem solve in mathematics;
(h) quality of knowledge acquired;
(i) ability to complete investigative tasks.

Clearly there are differences in the attitudes and perceptions of teachers and head-teachers in relation to children's communication skills, i.e., listening, oral and writing skills. In addition, respondents' views are seen to differ on aspects of quality and quantity of knowledge acquired by children.

Such differences possibly exist as a result of the separate roles undertaken by teacher and head-teacher. For example, whilst the primary function of a head-teacher is to lead the school, develop strategies and organise overall resources to achieve set targets, they have very limited, if any, teaching contact time or regular access to children within the learning situation. Alternatively, teachers must organise and plan work as required by head-teachers, however the major focus of their activity throughout the working day is with the children they teach. Therefore more assessment time and evaluation activities arise on which to form their perception of the situation in relation to knowledge gained by children.

Considering responses made by the grouping of head-teachers and deputy head-teachers, differences in perception exist on issues of writing, comprehension of oral speech and the quality of knowledge acquired by the children. It is useful to consider here the two distinct staff roles as one of management function as in the case of head-

(e) sense of responsibility;

(f) willingness to volunteer ideas.

Table 7.2 Perceptions of deputy head-teachers and head-teachers on children's affective domain

Item (1 of 9 items)	Group	N	Mean Rank	Sum of Ranks	Mann-Whitney	Sig.
q.13. Children's regular attendance	Deputy head-teacher	48	44.50	2136.00	960.000	.001
	Head-teacher	50	54.30	2715.00	960.000	.001
q.19. Children's interest for learning	Deputy head-teacher	48	43.67	2096.00	920.000	.029
	Head-teacher	50	55.10	2755.00	920.000	.029
q. 20. Children's level of commitment	Deputy head-teacher	48	44.00	2112.00	936.000	.046
	Head-teacher	50	54.78	2739.00	936.000	.046

The null hypothesis is accepted in eight of the nine items within the grouping of teacher against deputy head-teacher. Similar perceptions are held on the issues of children's:

(a) conduct in school;

(b) respect towards teachers;

(c) co-operation among children;

(d) willingness to co-operate with teacher;

(e) sense of responsibility;

(f) interest for learning;

(g) level of commitment;

(h) willingness to volunteer ideas.

When considering respondents' roles in school and their attitude and perceptions of children's affective domain there was no significant difference between teachers and head-teachers, where the null hypothesis was accepted for all nine items in this category.

Considering these results, in addition to the results of the global responses reported in Chapter 6, issues relating to behaviour traits within and towards school are indicated by many as perceiving a worsening of the situation.

Considering the perceptions of teachers and deputy head-teachers, the null hypothesis is accepted in eight of the nine items, the exception being based upon children's regular attendance at school (see Section 6.3.3).

The grouping of head-teacher and deputy head-teacher accepted the null hypothesis in six of the nine items. Rejections occurred based upon aspects of attendance and more critically, children's interest for learning along with children's level of commitment. Unfortunately, having identified differences in perception between the two groups, the trend identified within the global result element of the analysis shows a perceived worsening of the situation on these issues generally. A major influence upon these factors may possibly arise from successive Governments making constant attacks upon particular elements of education via the mass media.

7.3.1 Summary of Findings

Common perceptions and consensus were found on the issues of:

- Children's conduct in school (worsening trend)
- Children's respect towards teachers (worsening trend)
- Co-operation among children (worsening trend)
- Willingness to co-operate with teacher (worsening trend)
- Children's sense of responsibility (worsening trend)
- Children's willingness to volunteer ideas (improving trend)

7.4 SECTION C – TEACHERS' ATTITUDES

<u>*Research Question:*</u> *In what ways has the National Curriculum affected staff attitudes with respect to staff morale within the teaching profession?*

From Table 7.3 the null hypothesis is accepted in seven of the nine items within the grouping of teacher against head-teacher. There are no differences in perception on the issues of teachers':

(a) attention to weak students;
(b) attitude towards classroom work;
(c) attitude towards homework;
(d) attitudes towards innovations;
(e) attitudes towards varying teaching styles;
(f) sense of duty;
(g) interest in pursuing further studies.

Table 7.3 Perceptions of teachers and head-teachers on teachers' attitudes

Item (1 of 9 items)	Group	N	Mean Rank	Sum of Ranks	Mann-Whitney	Sig.
q.22. teachers' degree of preparation	Teacher	176	109.10	19202.00	3626.000	.049
	Head-teacher	50	128.98	6449.00	3626.000	.049
q.28. Teachers attitude towards the importance of pupil assessment	Teacher	176	108.11	19028.00	3452.000	.017
	Head-teacher	50	132.46	6623.00	3452.000	.017

When analysing respondents by school role of their perceptions about staff attitudes, it was found that teachers and deputy head-teachers, along with the grouping of deputy head-teachers and head-teachers, accepted the null hypothesis in all nine items within the section therefore their perceptions align closely. However, as reported in Section 6.3.4, overall trends are favourable with perceptions on teachers' attitudes being improved overall as a result of the introduction of the National Curriculum.

Considering the grouping of teachers and head-teachers perceptions on changes in teachers attitudes seven of the nine hypothesis are accepted, with differences in perception on issues of teachers' degree of preparation and teachers attitudes towards the importance of pupil assessment. Clearly from Section 6.3.4, there is a favourable trend of overall improvement in the situation. Differences in degree of perception possibly occurs from the differing role in which the person undertakes the two items. For example, pupil assessment traditionally among primary school teachers has been used primarily to identify what the children know, and then go on to diagnose problem areas of learning which may then be used to inform future planning and preparation of future teaching. However, with the introduction of SAT's and the associated elements of target setting as a basis for school and individual pupil improvement, many underlying principles for the need and value of pupil assessment have changed. That is particularly so from the head-teachers perspective, who are continually under pressure to improve standards within school in an attempt to achieve not school initiated, but rather central government standards of successful criteria of schools.

7.4.1 Summary of Findings

Common perceptions and consensus were found on the issues of:

- Teachers' attention to weak students (improving trend)
- Teachers' attitude towards classroom work (improving trend)
- Teachers' attitude towards homework (improving trend)
- Teachers' attitude towards innovations (improving trend)
- Teachers' attitude towards varying teaching styles (improving trend)
- Teachers' attitude towards the importance of pupil assessment (improving trend)
- Teachers' sense of duty (improving trend)
- Teachers' interest in pursuing further studies (worsening trend)

7.5 SECTION D – TEACHERS' SUPPORT MECHANISMS

Research Question: Has the National Curriculum created a climate in which staff may call upon colleagues expertise and experience in the form of support mechanisms for delivering the curriculum?

From Table 7.4 the null hypothesis is accepted in one of the eight items within the grouping of teacher against head-teacher. The same perception was identified on one issue within this section, that is: (a) Subject co-ordinators support of teachers.

Table 7. 4 Perception of teachers and head-teachers on teachers' support mechanisms

Item (1 of 8 items)	Group	N	Mean Rank	Sum of Ranks	Mann-Whitney	Sig.
q.31. Initial level of newly qualified teachers	Teacher	176	109.05	19192.00	3616.000	.037
	Head-teacher	50	129.18	6459.00	3616.000	.037
q.32. Quality of provision of in-service training for teachers	Teacher	176	108.11	19028.00	3452.000	.014
	Head-teacher	50	132.46	6623.00	3452.000	.014
q.33. Head-teachers' guidance on teachers	Teacher	176	105.31	18534.00	2958.000	.000
	Head-teacher	50	142.34	7117.00	2958.000	.000
q.34. The advice offered by other colleagues	Teacher	176	105.40	18550.00	2974.000	.000
	Head-teacher	50	142.02	7101.00	2974.000	.000
q.35. Teachers' knowledge related to quantity of subjects	Teacher	176	105.91	18640.00	3064.000	.001
	Head-teacher	50	141.22	7011.00	3064.000	.001
q.36. Teachers' knowledge related to quantity of subjects	Teacher	176	106.09	18672.00	3096.000	.001
	Head-teacher	50	139.58	6979.00	3096.000	.001
q.37. Teachers' classroom performance	Teacher	176	107.02	18836.00	3268.000	.004
	Head-teacher	50	136.30	6815.00	3268.000	.004

Similarly, the null hypothesis is accepted in four of the eight items within the grouping of teacher against deputy head-teacher. The same perception arose on issues of:

(a) initial level of newly qualified teachers;
(a) teachers' knowledge related to quality of teaching required;
(b) classroom performance;
(c) subject co-ordinators support of teachers.

Within responses between staff roles and teachers' support mechanisms clearly deputy head-teachers and head-teachers, accepted the null hypothesis in all eight items within the Section thereby indicating no differences in perception within this grouping on these aspects.

Differences in perception occur between teachers and deputy head-teachers in four of the eight items based mainly upon issues of in-service training, head-teachers guidance, colleagues advice and teachers knowledge in relation to the quantity of subjects demanded by the National Curriculum. Critically however, as seen in Section 6.3.5, the overall response to these aspects shows favourable trends to situations of improvement. Therefore the differences in perception indicated here, relate to the perceived extent to which the situation has improved, as opposed to whether the situation has improved or not.

Additionally, more pronounced differences in degree of attitudes and opinions occur between the grouping of teachers and head-teachers, where the null hypothesis is rejected in seven of the eight items in this section, the exception being subject co-ordinators support for teachers. Whilst differences in perception does exist between these two groups, from further consideration of Section 6.3.5, all concerned agree the situation has improved as a result of introducing the National Curriculum. Differences in perception reported here therefore, relate to the extent and degree to which the situation has improved resulting from the innovation.

7.5.1 Summary of Findings

Common perceptions and consensus were found on the issue of:

- Subject co-ordinators support of teachers (improving trend)

7.6 SECTION E – OBJECTIVES/OUTCOMES

> Research Question: *Has the National Curriculum provided clarity in terms of the objectives and outcomes schools are able to set for their mathematics teaching?*

From Table 7.5 the null hypothesis is accepted in four of the six items within the grouping teacher against head-teacher. Similar perceptions are held on the issues of:

(a) the clarity of the schools objectives in mathematics;
(b) the clarity of the school's outcomes in mathematics;
(c) the clarity of the curriculum outcomes in mathematics;
(d) the clarity of the objectives in teaching.

Table 7.5 : Perceptions of teachers and head-teachers on objectives/ outcomes

Item (1 of 6 items)	Group	N	Mean Rank	Sum of Ranks	Mann-Whitney	Sig.
q.41. Clarity of objectives in mathematics	Teacher	176	107.42	18906.00	3330.000	.004
	Head-teacher	50	134.90	6745.00	3330.000	.004
q.44. The presence of objectives in all aims	Teacher	176	107.67	18950.00	3374.000	.006
	Head-teacher	50	134.02	6701.00	3374.000	.006

The null hypothesis is accepted in five of the six items within the grouping of deputy head-teacher against head-teacher. Close perceptions were identified on the issues of:

(a) the clarity of the schools objectives in mathematics;

(b) the clarity of the school's outcomes in mathematics;
(c) the clarity of the curriculum outcomes in mathematics;
(d) the clarity of the objectives in teaching;
(e) the presence of objectives in all aims.

Perceptions and attitudes of staff in relation to objectives/ outcomes within school, clearly demonstrated in Section 6.3.6 are extremely positive with perceived favourable trends in every item of the section.

Differences in perception indicated here will therefore relate to the extent and degree to which the situation has improved in contrast to whether the situation has improved or worsened.

The perceptions of teachers and deputy head-teachers align closely within this section with the null hypothesis accepted in all six items. Teachers and head-teachers differ in attitude and perception in two of the six items. That is, issues of clarity of objectives in mathematics and the relationship of aims and objectives. The null hypothesis being accepted in four of the six items in the section indicating there are no significant differences in perception within this grouping.

Comparing deputy head-teachers with head-teachers, differences in perception occur on the issue of clarity of objectives in mathematics. The null hypothesis being accepted in five of the six items in the section.

7.6.1 Summary of Findings

Common perceptions and consensus were found on the issues of:

- The clarity of your schools objectives in mathematics (improving trend)
- The clarity of your school's outcomes in mathematics (improving trend)
- The clarity of your curriculum outcomes in mathematics (improving trend)
- The clarity of your objectives in teaching (improving trend)

7.7 SECTION F – CURRICULUM CONTENT

<u>Research Question:</u> In relation to the content of the mathematics syllabus, does the National Curriculum provide a viable curriculum?

From Table 7.6 the null hypothesis is accepted in five of the seven items within the grouping of deputy head-teacher against head-teacher. Similar perceptions arose on issues of:

(a) the quantity of mathematics taught;
(b) the standard of mathematics taught;
(c) time which is allotted to teaching mathematics;
(d) the variety of textbooks used in teaching of mathematics;
(e) the general presentation of mathematics textbooks used by you.

Table 7.6 Perceptions of deputy head-teachers and head-teachers on curriculum content

Item (1 of 7 items)	Group	N	Mean Rank	Sum of Ranks	Mann-Whitney	Sig.
q.48. The quality of new textbooks published on mathematics	Deputy head-teacher	48	55.92	2684.00	892.000	.015
	Head-teacher	50	43.34	2167.00	892.000	.015
q. 50. The content of mathematics textbooks used in your classroom	Deputy head-teacher	48	56.33	2704.00	872.000	.011
	Head-teacher	50	42.94	2147.00	872.000	.011

Likewise, the null hypothesis is accepted in four of the seven items within the grouping of teacher against deputy head-teacher. Similar perceptions were identified on the issues of:

(a) the quantity of mathematics taught;
(b) the standard of mathematics throughout Key Stage 2;
(c) time which is allotted to teaching mathematics;
(d) the variety of textbooks used in teaching mathematics.

Considering respondents according to their roles in schools and their attitudes and perceptions towards curriculum content, teachers and head-teachers aligned closely, i.e., the null hypothesis was accepted on all seven items in this section indicating no difference in attitude or perception within the group.

Considering teachers and deputy head-teachers the null hypothesis was accepted in four of the seven items. Differences in perception occurred on issues of quality, content and general presentation of mathematics textbooks. Significantly, from Section 6.3.7, the global responses to the issues were an extremely favourable perception of the situation having improved significantly. The differences in perception cited here relate to the degree to which improvement has been made on these issues.

Likewise, when considering deputy head-teachers and head-teachers, the null hypothesis was accepted in five of the seven items in the section. Differences arose on issues of quality and content of mathematical textbooks used within schools.

7.7.1 Summary of Findings

Common perceptions and consensus were found on the issues of:

- The quantity of mathematics taught by you (improving trend)
- The standard of mathematics throughout key stage 2 (improving trend)
- Time which is allotted to teaching mathematics (improving trend)

7.8 SECTION G – CURRICULUM METHODOLOGY

<u>Research Question:</u> *Has the National Curriculum provided a catalyst for the development and refinement of curriculum methodology?*

From Table 7.7 the null hypothesis is accepted in six of the eight items within the grouping of teacher against head-teacher. Similar perceptions arose on the issues of:

(a) the use of teaching aids;
(b) matching of the mathematics taught with the children's ability levels;

(c) atmosphere in classrooms to enable learning;
(d) appropriateness of classroom organisation;
(e) the introduction of new methods within your classroom;
(f) methodological recommendations offered in mathematical texts.

Table 7.7 : Perceptions of teachers and head-teachers on curriculum methodology

Item (1 of 8 items)	Group	N	Mean Rank	Sum of Ranks	Mann-Whitney	Sig.
q.56. Information given to teachers about innovations	Teacher	176	108.22	19046.00	3470.000	.015
	Head-teacher	50	132.10	6605.00	3470.000	.015
q.58. Teachers' attitude towards the introduction of new methods	Teacher	176	103.36	18192.00	2616.000	.000
	Head-teacher	50	149.18	7459.00	2616.000	.000

The null hypothesis is accepted in seven of the eight items within the grouping of deputy head-teacher against head-teacher. Similar perceptions were identified on the issues of:

(a) the use of teaching aids;
(b) matching of the mathematics taught with the children's ability levels;
(c) atmosphere in classrooms to enable learning;
(d) appropriateness of classroom organisation;
(e) information given to teachers about innovations;
(f) the introduction of new methods within your classroom;
(g) methodological recommendations offered in mathematical texts.

Similarly, the null hypothesis is accepted in seven of the eight items within the grouping of teacher against deputy head-teacher. Similar perceptions were seen on the issues of:

(a) the use of teaching aids;

(b) matching of the mathematics taught with the children's ability levels;

(c) atmosphere in classrooms to enable learning;

(d) appropriateness of classroom organisation;

(e) the introduction of new methods within your classroom;

(f) teachers' attitude towards the introduction of new methods;

(g) methodological recommendations offered in mathematical texts.

Considering staff roles within school and their attitude and perceptions towards curriculum methodology, deputy head-teachers and head-teachers aligned very closely, with the null hypothesis being accepted in seven of the eight items in the section. Differences in perception appeared on the aspect of teachers attitudes towards the introduction of new methods.

Similarly, teachers and deputy head-teachers when considered as a group, accepted the null hypothesis in seven of the eight items, with the null hypothesis rejected on the issue of information given to teachers about innovations. Additionally, when considering teachers and head-teachers, the null hypothesis was rejected for issues of information given to teachers about innovations and teachers attitude towards the introduction of new methods.

Generally however, as indicated in Section 6.3.8, the overall situation relating to curriculum methodology is perceived to have improved as a result of introducing the National Curriculum within schools.

7.8.1 Summary of Findings

Common perceptions and consensus were found on the issues of:

- Your use of teaching aids (improving trend)
- Matching of the mathematics taught with children's ability level (improving trend)
- Atmosphere in classrooms to enable learning (improving trend)
- Appropriateness of classroom organisation (improving trend)
- The introduction of new methods within your classroom (improving trend)

- Methodological recommendations offered in mathematical texts (improving trend)

7.9 SECTION H – SCHOOL/COMMUNITY

<u>Research Question:</u> *Has the National Curriculum provided benefits in terms of improved relationships between the school and the wider external community?*

From Table 7.8 the null hypothesis is accepted in two of the five items within the grouping of teacher against head-teacher. Similar perspectives were held on issues of:

(a) relations between teachers and parents;
(b) parents' respect for teachers.

Table 7.8 : Perceptions of teachers and head-teachers on school/community relationships

Item (1 of 5 items)	Group	N	Mean Rank	Sum of Ranks	Mann-Whitney	Sig.
q.62. The co-operation of the community with the school	Teacher	176	114.33	20122.00	3456.000	.013
	Head-teacher	50	110.58	5529.00	3456.000	.013
q.63. Community's respect for school	Teacher	176	107.53	18926.00	3350.000	.006
	Head-teacher	50	134.50	6725.00	3350.000	.006
q.64. The influence of school within the community	Teacher	176	105.77	18616.00	3040.000	.000
	Head-teacher	50	140.70	7035.00	3040.000	.000

The null hypothesis is accepted in four of the five items within the grouping of deputy head-teacher against head-teacher. Similar perceptions arose on issues of:

(a) relations between teachers and parents;
(b) parents respect for teachers;
(c) the co-operation of the community with the school;
(d) communities respect for school.

Considering the school and its relationships within the community, the group of teachers and deputy head-teachers resulted in the null hypothesis being accepted in all five items indicating no difference in attitude or perception on these items.

Differences in perception and attitude appear between teachers and head-teachers, where the null hypothesis is rejected in three out of the five items. Differences exist on the issues of co-operation of the community with the school, communities respect for the school along with the influence of the school within the community.

The grouping of deputy head-teacher and head-teacher, accepted the null hypothesis in four of the five items. Difference in perception appear on the issue of the influence of the school within the community.

Significantly however, the global responses outlined in section 6.3.9 indicate that issues of mutual respect between parents, community and school have deteriorated considerably since the introduction of the National Curriculum framework.

7.9.1 Summary of Findings

Common perceptions and consensus were found on the issues of:

- Relations between teachers and parents (improving trend)
- Parents' respect for teachers (worsening trend)

7.10 SECTION I – MATHEMATICAL TEXTBOOKS

<u>Research Question:</u> *Has the National Curriculum initiated development and improvements in relation to mathematical textbooks available for delivering the subject?*

From Table 7.9 the null hypothesis is accepted in eleven of the twelve items within the grouping of teacher against head-teacher. Teachers and head-teachers have similar perceptions on the issues of:

(a) the quality of graphs, pictures, tables and diagrams used;

(b) the number of tasks provided for children to solve;

(c) textbooks are too abstract for the children they are produced for;
(d) provides a content that meets the children's needs;
(e) restricts my teaching methods;
(f) do not follow the logical sequence of the subject;
(g) are adequate for children's self-study;
(h) present examples, activities and exercises relevant to the children's experience;
(i) greatly assist in lesson preparation;
(j) do not include material in the form of motivation or enrichment topics;
(k) are accompanied by Teachers' Manuals used regularly.

Table 7. 9 : Perceptions of teachers and head-teachers on mathematical textbooks

Item (1 of 12 items)	Group	N	Mean Rank	Sum of Ranks	Mann-Whitney	Sig.
q.70. Present mathematical content accurately	Teacher	176	107.80	18972.00	3396.000	.004
	Head-teacher	50	133.58	6679.00	3396.000	.004

Considering responses in terms of roles within schools, resulted in the groups of teachers and deputy head-teachers, along with deputy head-teachers and head-teachers both accepting the null hypothesis in all twelve items, demonstrating attitudes and perceptions of these groupings align significantly on these issues.

The third group of teachers and head-teachers, accepted the null hypothesis in eleven of the twelve items with the exception based upon the issue of whether textbooks present mathematical content accurately.

As outlined in section 6.3.10, overall respondents perceived a considerable improvement in the overall situation with regard the practice of using mathematical textbooks in the teaching of mathematics within the classroom situation.

7.10.1 Summary of Findings

Common perceptions and consensus were found on the issues of:

- The quality of graphs, pictures, tables and diagrams you use (improving trend)
- The number of tasks provided for children to solve (improving trend)
- Are too abstract for the children's age they are produced for (improving trend)
- Provides a content that meets the children's needs (improving trend)
- Restricts my teaching methods (improving trend)
- Do not follow the logical sequence of the subject (worsening trend)
- Are adequate for children's self-study (worsening trend)
- Present examples, activities and exercises relevant to the children's experience (improving trend)
- Greatly assist me in lesson preparation (improving trend)
- Do not include material in the form of motivation or enrichment topics (improving trend)
- Are accompanied by Teachers' Manuals I use regularly (improving trend)

7.11 SECTION J – PROPORTION OF TEACHING TIME

Research Question: Has the National Curriculum provided clarity in relation to the adoption of specific subject teaching methodologies within schools?

From Table 7.10 the null hypothesis is accepted in eight of the ten items within the grouping of teacher against head-teacher. Similar perceptions appeared on the issues of:

(a) lecture method;
(b) demonstration/illustration;
(c) drill and practice;
(d) problem solving;
(e) the expository style;
(f) investigational work;
(g) practical activity;
(h) programmed learning.

Table 7. 10 : Perceptions of teachers and head-teachers on use of teaching time

Item (1 of 10 items)	Group	N	Mean Rank	Sum of Ranks	Mann-Whitney	Sig.
q. 79. Discussion	Teacher	176	106.83	18802.00	3226.000	.002
	Head-teacher	50	136.98	6849.00		
q.82. Discovery Approaches	Teacher	176	106.10	18674.00	3098.000	.001
	Head-teacher	50	139.54	6977.00		

The null hypothesis is accepted in seven of the ten items within the grouping of deputy head-teacher against head-teacher. Similar perceptions were identified on the issues of:

(a) lecture method;
(b) discussion;
(c) discovery Approaches;
(d) the expository style;
(e) investigational work;
(f) practical activity;
(g) programmed learning.

Similarly, the null hypothesis is accepted in seven of the ten items within the section of teacher against deputy head-teacher. Similar perceptions arose on the issues of:

(a) lecture method;
(b) discussion;
(c) discovery Approaches;
(d) the expository style;
(e) investigational work;
(f) practical activity;
(g) programmed learning.

Considering roles of respondents on time spent using specific teaching methodologies, deputy head-teachers and head-teachers, accepted the null hypothesis in seven of the ten items. Differences in perception appeared on the issues of demonstration/ illustration, drill and practice and problem solving methodologies. This finding was replicated when considering the grouping of deputy head-teachers and teachers.

Additionally, from the group of teachers and head-teachers, the null hypothesis was accepted in eight of the ten items. However, it was rejected on two items based upon discussion and discovery approaches to teaching mathematics.

Critically, on the issue of methodology, the global responses from section 6.3.11, demonstrate that every aspect of methodology is perceived as a favourable trend, that is, one of improvement. Significantly so in the areas of problem solving, investigational work and practical activity.

7.11.1 Summary of Findings

Common perceptions and consensus were found on the issues of:

- Lecture Method (improving trend)
- The expository style (improving trend)
- Investigative Work (improving trend)
- Practical Activity (improving trend)
- Programmed learning (improving trend)

7.12 SECTION K – GENERAL QUESTION

Research Question: *Has the National Curriculum improved the chances of raising standards in primary education?*

From Table 7.11, the null hypothesis is rejected within the grouping of deputy head-teacher against head-teacher.

Table 7. 11 : Perceptions of deputy head-teachers and headteachers on chances of National Curriculum raising standards

Item (1 of 1 items)	Group	N	Mean Rank	Sum of Ranks	Mann-Whitney	Sig.
q.87. NC improved chances of raising standards	Deputy head-teacher	48	43.42	2084.00	908.000	.032
	Head-teacher	50	55.34	2767.00	908.000	.032

Considering respondents in relation to perceiving if the introduction of the National Curriculum has improved the chances of raising standards in primary education, the results show teachers and head-teachers, along with teachers and deputy head-teachers accepted the null hypothesis indicating alignment of perceptions. The null hypothesis was rejected when considering the responses of deputy head-teachers against head-teachers, indicating a difference in attitude or perception on this substantive issue. However, as found in Section 6.3.12, the global perception on this issue is one of improvement. Therefore, the differences identified in perception here relates to the degree to which improvement was made in this issue.

However, considering global responses to this issue in section 6.3.12, clearly the introduction of the national curriculum is perceived to have had an effect upon the chances of raising standards in primary schools. This general question received a broad range of responses. Significantly and critically just over 48% of respondents perceive the introduction of the National Curriculum has resulted in an improved situation, with 13.1% indicating no change in the situation.

7.12.1 Summary of Findings

Common perceptions and consensus were found on the issue of:

- Overall, do you think the changes introduced by the National Curriculum have improved/worsened the likelihood of raising standards in primary education (improving trend).

CHAPTER 8

COMPARATIVE ANALYSIS BASED UPON PERSONAL RELATED FACTORS

8.1 INTRODUCTION

In this chapter the perceptions of males and females, along with teaching experience in terms of time teaching, are compared. Each of the research questions investigated in Chapter 6 is re-visited and the corresponding null hypothesis tested for differences between pair-wise groups. In order to aid clarity the relevant research questions are reproduced as subheadings. In each the null hypothesis is implicit and reinforced in Chapter 6. As stated earlier the tabulations show only significant results.

Significantly, for the grouping of males against females the null hypothesis was rejected in all eighty seven items. This clearly indicates a significant difference in perception and attitude between male and female teaching staff.

8.2 SECTION A – CHILDREN'S KNOWLEDGE

<u>Research Question:</u> *Has the National Curriculum provided benefits in terms of the knowledge gained by pupils?*

From Table 8.1, the null hypothesis is rejected on all items within the grouping of males against females.

Table 8.1: Perception of males and females on children's knowledge

Item (1 of 12 items)	Group	N	Mean Rank	Sum of Ranks	Mann-Whitney	Sig.
q.1. Children's reading skills	Male	131	88.35	11573.50	2927.500	.000
	Female	143	182.53	26101.50	2927.500	.000
q.2. Children's ability to comprehend written passages	Male	131	86.42	11320.50	2674.500	.000
	Female	143	184.30	26354.50	2674.500	.000
q.03. Children's oral skills	Male	131	94.84	12423.50	3777.500	.000
	Female	143	176.58	25251.50	3777.500	.000
q.04. Children's ability to comprehend oral speech	Male	131	102.76	13461.50	4815.500	.000
	Female	143	169.33	24213.50	4815.500	.000
q.5. Children's listening skills	Male	131	87.91	11516.50	2870.500	.000
	Female	143	182.93	26158.50	2870.500	.000
q.6. Children's writing	Male	131	85.42	11190.50	2544.500	.000
	Female	143	185.21	26484.50	2544.500	.000
q.07. Children's ability to perform written commands	Male	131	91.81	12027.50	3381.500	.000
	Female	143	179.35	25647.50	3381.500	.000
q.08. Children's ability in computation	Male	131	84.60	11082.50	2436.500	.000
	Female	143	185.96	26592.50	2436.500	.000
q.09. The ability to problem solve in mathematics	Male	131	87.11	11411.50	2765.500	.000
	Female	143	183.66	26263.50	2765.500	.000
q.10. The quality of knowledge acquired by children	Male	131	86.87	11380.50	2734.500	.000
	Female	143	183.88	26294.50	2734.500	.000
q.11. The quantity of knowledge acquired by children	Male	131	90.77	11890.50	3244.500	.000
	Female	143	180.31	25784.50	3244.500	.000
q.12. The ability to complete investigative tasks	Male	131	91.13	11937.50	3291.500	.000
	Female	143	179.98	25737.50	3291.500	.000

8.3 SECTION B – CHILDREN'S AFFECTIVE DOMAIN

<u>Research Question:</u> *Has the National Curriculum enhanced the schools' overall ethos in relation to developing the affective domain of the pupils?*

From Table 8.2, the null hypothesis is rejected on all items within the grouping of males against females.

Table 8.2: Perception of males and females children's affective domain

Item (1 of 9 items)	Group	N	Mean Rank	Sum of Ranks	Mann-Whitney	Sig.
q.13. Children's regular attendance	Male	131	122.48	16044.50	7398.500	.000
	Female	143	151.26	21630.50	7398.500	.000
q.14. Children's conduct in school	Male	131	80.55	10552.50	1906.500	.000
	Female	143	189.67	27122.50	1906.500	.000
q.15. Children's respect towards teachers	Male	131	81.07	10620.50	1974.500	.000
	Female	143	189.19	27054.50	1974.500	.000
q.16. Co-operation among children	Male	131	98.65	12922.50	4276.500	.000
	Female	143	173.09	24752.50	4276.500	.000
q.17. Willingness to co-operate with teacher	Male	131	99.35	13014.50	4368.500	.000
	Female	143	172.45	24660.50	4368.500	.000
q.18. Children's sense of responsibility	Male	131	88.73	11623.50	2977.500	.000
	Female	143	182.18	26051.50	2977.500	.000
q.19. Children's interest for learning	Male	131	88.57	11602.50	2956.500	.000
	Female	143	182.33	26072.50	2956.500	.000
q. 20. Children's level of commitment	Male	131	92.96	12177.50	3531.500	.000
	Female	143	178.30	25497.50	3531.500	.000
q.21. Children's willingness to volunteer ideas	Male	131	94.03	12317.50	3671.500	.000
	Female	143	177.33	25357.50	3671.500	.000

8.4 SECTION C – TEACHERS' ATTITUDES

<u>Research Question:</u> *In what ways has the National Curriculum affected staff attitudes with respect to staff morale within the teaching profession?*

From Table 8.3, the null hypothesis is rejected on all items within the grouping of males against females.

Table 8.3 Perception of males and females on teachers' attitudes

Item (1 of 9 items)	Group	N	Mean Rank	Sum of Ranks	Mann-Whitney	Sig.
q.22. teachers' degree of preparation	Male	131	88.81	11634.50	2988.500	.000
	Female	143	182.10	26040.50	2988.500	.000
q.23. Teachers' attention to weak students	Male	131	87.45	11456.50	2810.500	.000
	Female	143	183.35	26218.50	2810.500	.000
q.24. Teachers' attitude towards classroom work	Male	131	88.81	11633.50	2987.500	.000
	Female	143	182.11	26041.50	2987.500	.000
q.25. Teachers' attitude towards homework	Male	131	96.85	12687.50	4041.500	.000
	Female	143	174.74	24987.50	4041.500	.000
q.26. Teachers' attitude towards innovations	Male	131	83.44	10930.50	2284.500	.000
	Female	143	187.02	26744.50	2284.500	.000
q.27. Teachers' attitude towards varying teaching styles	Male	131	94.40	12366.50	3720.500	.000
	Female	143	176.98	25308.50	3720.500	.000
q.28. Teachers attitude towards the importance of pupil assessment	Male	131	89.70	11750.50	3104.500	.000
	Female	143	181.29	25924.50	3104.500	.000
q.29. Teachers' sense of duty	Male	131	94.65	12398.50	3752.500	.000
	Female	143	176.76	25276.50	3752.500	.000
q.30. Teachers' interest in pursuing further studies	Male	131	90.08	11800.50	3154.500	.000
	Female	143	180.94	25874.50	3154.500	.000

8.5 SECTION D – TEACHERS' SUPPORT MECHANISMS

<u>Research Question:</u> *Has the National Curriculum created a climate in which staff may call upon colleagues expertise and experience in the form of support mechanisms for delivering the curriculum?*

From Table 8.4, the null hypothesis is rejected on all items within the grouping of males against females.

Table 8.4: Perception of males and females on teachers' support mechanisms

Item (1 of 8 items)	Group	N	Mean Rank	Sum of Ranks	Mann-Whitney	Sig.
q.31. Initial level of newly qualified teachers	Male	131	94.66	12400.50	3754.500	.000
	Female	143	176.74	25274.50	3754.500	.000
q.32. Quality of provision of in-service training for teachers	Male	131	91.60	11999.50	3353.500	.000
	Female	143	179.55	25675.50	3353.500	.000
q.33. Head-teachers' guidance on teachers	Male	131	99.68	13057.50	4411.500	.000
	Female	143	172.15	24617.50	4411.500	.000
q.34. The advice offered by other colleagues	Male	131	91.74	12018.50	3372.500	.000
	Female	143	179.42	25656.50	3372.500	.000
q.35. Teachers' knowledge related to quantity of subjects	Male	131	97.01	12708.50	4062.500	.000
	Female	143	174.59	24966.50	4062.500	.000
q.36. Teachers' knowledge related to quantity of subjects	Male	131	92.34	12096.50	3450.500	.000
	Female	143	178.87	25578.50	3450.500	.000
q.37. Teachers' classroom performance	Male	131	97.42	12761.50	4115.500	.000
	Female	143	174.22	24913.50	4115.500	.000
q.38. Subject co-ordinators support for teachers	Male	131	91.71	12014.50	3368.500	.000
	Female	143	179.44	25660.50	3368.500	.000

8.6 SECTION E – OBJECTIVES/ OUTCOMES

<u>Research Question:</u> *Has the National Curriculum provided clarity in terms of the objectives and outcomes schools are able to set for their mathematics teaching?*

From Table 8.5, the null hypothesis is rejected on all items within the grouping of males against females.

Table 8.5: Perception of males and females on objectives/ outcomes

Item (1 of 6 items)	Group	N	Mean Rank	Sum of Ranks	Mann-Whitney	Sig.
q. 39. Clarity of your schools objectives in mathematics	Male	131	92.06	12059.50	3413.500	.000
	Female	143	179.13	25615.50	3413.500	.000
q.40. Clarity of your school's outcomes in mathematics	Male	131	91.61	12001.50	3355.500	.000
	Female	143	179.53	25673.50	3355.500	.000
q.41. Clarity of objectives in mathematics	Male	131	96.66	12662.50	4016.500	.000
	Female	143	174.91	25012.50	4016.500	.000
q.42. Clarity of your curriculum outcomes in mathematics	Male	131	97.53	12776.50	4130.500	.000
	Female	143	174.12	24898.50	4130.500	.000
q.43. The clarity of your objectives in teaching	Male	131	96.86	12688.50	4042.500	.000
	Female	143	174.73	24986.50	4042.500	.000
q.44. The presence of objectives in all aims	Male	131	98.07	12847.50	4201.500	.000
	Female	143	173.62	24827.50	4201.500	.000

8.7 SECTION F – CURRICULUM CONTENT

Research Question: In relation to the content of the mathematics syllabus, does the National Curriculum provide a viable curriculum?

From Table 8.6, the null hypothesis is rejected on all items within the grouping of males against females.

Table 8.6: Perception of males and females on curriculum content

Item (1 of 7 items)	Group	N	Mean Rank	Sum of Ranks	Mann-Whitney	Sig.
Q.45. The quantity of mathematics taught by you	Male	131	86.87	11380.50	2734.500	.000
	Female	143	183.88	26294.50	2734.500	.000
q.46. The standard of mathematics throughout Key Stage 2	Male	131	93.03	12187.50	3541.500	.000
	Female	143	178.23	25487.50	3541.500	.000
q.47. Time which is allotted to teaching mathematics	Male	131	88.84	11637.50	2991.500	.000
	Female	143	182.08	26037.50	2991.500	.000
q.48. The quality of new textbooks published on mathematics	Male	131	90.19	11815.50	3169.500	.000
	Female	143	180.84	25859.50	3169.500	.000
q.49. The variety of textbooks used by you in teaching of mathematics	Male	131	85.30	11174.50	2528.500	.000
	Female	143	185.32	26500.50	2528.500	.000
q. 50. The content of mathematics textbooks used in your classroom	Male	131	93.69	12273.50	3627.500	.000
	Female	143	177.63	25401.50	3627.500	.000
q. 51. The general presentation of mathematics textbooks used by you	Male	131	95.91	12564.50	3918.500	.000
	Female	143	175.60	25110.50	3918.500	.000

8.8 SECTION G – CURRICULUM METHODOLOGY

<u>Research Question:</u> *Has the National Curriculum provided a catalyst for the development and refinement of curriculum methodology?*

From Table 8.7, the null hypothesis is rejected on all items within this grouping of males against females.

Table 8.7: Perception of males and females on curriculum methodology

Item (1 of 8 items)	Group	N	Mean Rank	Sum of Ranks	Mann-Whitney	Sig.
q.52. Your use of teaching aids	Male	131	95.65	12530.50	3884.500	.000
	Female	143	175.84	25144.50	3884.500	.000
q.53. Matching of mathematics taught with children's ability level	Male	131	87.16	11418.50	2772.500	.000
	Female	143	103.61	26256.50	2772.500	.000
q.54. Atmosphere in classrooms to enable learning	Male	131	94.77	12415.50	3769.500	.000
	Female	143	176.64	25259.50	3769.500	.000
q.55. Appropriateness of classroom organisation	Male	131	97.87	12820.50	4174.500	.000
	Female	143	173.81	24854.50	4174.500	.000
q.56. Information given to teachers about innovations	Male	131	92.16	12073.50	3427.500	.000
	Female	143	179.03	25601.50	3427.500	.000
q.57. The introduction of new methods within your classroom	Male	131	93.86	12295.50	3649.500	.000
	Female	143	177.48	25379.50	3649.500	.000
q.58. Teachers' attitude towards the introduction of new methods	Male	131	94.31	12354.50	3708.500	.000
	Female	143	177.07	25320.50	3708.500	.000
q.59. Methodological recommendations offered in mathematical textbooks	Male	131	87.00	11396.50	2750.500	.000
	Female	143	183.77	26278.50	2750.500	.000

8.9 SECTION H – SCHOOL/ COMMUNITY

Research Question: Has the National Curriculum provided benefits in terms of improved relationships between the school and the wider external community?

From Table 8.8, the null hypothesis is rejected on all items within the grouping of males against females.

Table 8.8: Perception of males and females on school/ community relationships

Item (1 of 5 items)	Group	N	Mean Rank	Sum of Ranks	Mann-Whitney	Sig.
q. 60. Relations between teachers and parents	Male	131	97.58	12782.50	4136.500	.000
	Female	143	174.07	24892.50	4136.500	.000
q.61. Parents' respect for teachers	Male	131	86.78	11368.50	2722.500	.000
	Female	143	183.96	26306.50	2722.500	.000
q.62. The co-operation of the community with the school	Male	131	96.26	12609.50	3963.500	.000
	Female	143	175.28	25065.50	3963.500	.000
q.63. Community's respect for school	Male	131	93.05	12189.50	3543.500	.000
	Female	143	178.22	25485.50	3543.500	.000
q.64. The influence of school within the community	Male	131	97.92	12827.50	4181.500	.000
	Female	143	173.76	24847.50	4181.500	.000

8.10 SECTION I – MATHEMATICAL TEXTBOOKS

Research Question: Has the National Curriculum initiated development and improvements in relation to mathematical textbooks available for delivering the subject?

From Table 8.9, the null hypothesis is rejected on all items within the grouping of males against females.

Table 8.9 : Perception of males and females on mathematical textbooks

Item (1 of 12 items)	Group	N	Mean Rank	Sum of Ranks	Mann-Whitney	Sig.
q.65.The quality of graphs, pictures tables and diagrams you use	Male	131	90.15	11809.50	3163.500	.000
	Female	143	180.88	25865.50	3163.500	.000
q.66. The number of tasks provided for children to solve	Male	131	84.53	11073.50	2427.500	.000
	Female	143	186.02	26601.50	2427.500	.000
q.67. Are too abstract for the children's age they are produced for	Male	131	101.04	13236.50	4590.500	.000
	Female	143	170.90	24438.50	4590.500	.000
q.68. Provides a content that meets the children's needs	Male	131	98.34	12882.50	4236.500	.000
	Female	143	173.37	24792.50	4236.500	.000
q.69. Restricts my teaching methods	Male	131	104.68	13712.50	5066.500	.000
	Female	143	167.57	23962.50	5066.500	.000
q.70. Present mathematical content accurately	Male	131	106.04	13891.50	5245.500	.000
	Female	143	166.32	23783.50	5245.500	.000
q.71. Do not follow the logical sequence of the subject	Male	131	94.41	12367.50	3721.500	.000
	Female	143	176.98	25307.50	3721.500	.000
q.72. Are adequate for children's self study	Male	131	99.13	12986.50	4340.500	.000
	Female	143	172.65	24688.50	4340.500	.000
q.73. Present examples, activities and exercises relevant to the children's experience	Male	131	91.93	12042.50	3396.500	.000
	Female	143	179.25	25632.50	3396.500	.000
q.74. Greatly assist me in lesson preparation	Male	131	84.97	11131.50	2485.500	.000
	Female	143	185.62	26543.50	2485.500	000
q.75. Do not include material in the form of motivation or enrichment topics	Male	131	96.53	12645.50	3999.500	.000
	Female	143	175.03	25029.50	3999.500	.000
q. 76. Are accompanied by Teachers' Manuals I use regularly	Male	131	92.47	12113.50	3467.500	.000
	Female	143	178.75	25561.50	3467.500	.000

8.11 SECTION J – PROPORTION OF TEACHING TIME

<u>Research Question:</u> *Has the National Curriculum provided clarity in relation to the adoption of specific subject teaching methodologies within schools?*

From Table 8.10 , the null hypothesis is rejected on all items within the grouping of males against females.

Table 8.10 Perception of males and females on use of teaching time

Item (1 of 10 items)	Group	N	Mean Rank	Sum of Ranks	Mann-Whitney	Sig.
q.77. Lecture Method	Male	131	99.65	13054.50	4408.500	.000
	Female	143	172.17	24620.50	4408.500	.000
q.78. Demonstration/ illustration	Male	131	103.71	13586.50	4940.500	.000
	Female	143	168.45	24088.50	4940.500	.000
q. 79. Discussion	Male	131	98.26	12872.50	4226.500	.000
	Female	143	173.44	24802.50	4226.500	.000
q.80. Drill and Practice	Male	131	103.49	13557.50	4911.500	.000
	Female	143	168.65	24117.50	4911.500	.000
q.81. Problem Solving	Male	131	90.13	11806.50	3160.500	.000
	Female	143	180.90	25868.50	3160.500	.000
q.82. Discovery Approaches	Male	131	91.96	12046.50	3400.500	.000
	Female	143	179.22	25628.50	3400.500	.000
q.83. The expository Style	Male	131	95.39	12496.50	3850.500	.000
	Female	143	176.07	25178.50	3850.500	.000
q.84. Investigational work	Male	131	96.43	12632.50	3986.500	.000
	Female	143	175.12	25042.50	3986.500	.000
q.85. Practical Activity	Male	131	89.41	11712.50	3066.500	.000
	Female	143	181.56	25962.50	3066.500	.000
q.86. Programmed learning	Male	131	101.37	13279.50	4633.500	.000
	Female	143	170.60	24395.50	4633.500	.000

8.12 SECTION K - GENERAL QUESTION

Research Question: Has the National Curriculum improved the chances of raising standards in primary education?

From Table 8.11, the null hypothesis is rejected on all items within the grouping of males against females.

Table 8.11 : Perception of males and females in terms of raising standards

Item (1 of 1 items)	Group	N	Mean Rank	Sum of Ranks	Mann-Whitney	Sig.
q.87. NC improved chances of raising standards	Male	131	83.32	10915.50	2269.500	.000
	Female	143	187.13	26759.50	2269.500	.000

RESULTS BASED UPON TEACHING EXPERIENCE

8.13 SECTION A – CHILDREN'S KNOWLEDGE

Research Question: *Has the National Curriculum provided benefits in terms of the knowledge gained by pupils?*

From Table 8.12 the null hypothesis is accepted in eleven of the twelve items within the grouping of 3 – 7 years against 8 – 12 years teaching experience. Common perceptions exist on issues of:

(a) Reading skills
(b) Ability to comprehend written passages
(c) Oral skills
(d) Ability to comprehend oral speech
(e) Listening skills
(f) Writing
(g) Ability in computation
(h) Ability to problem solve in mathematics
(i) Quality of knowledge acquired
(j) Quantity of knowledge acquired
(k) Ability to complete investigative tasks

Table 8.12 : Perceptions in terms of teaching experience on children's knowledge

Item (1 of 12 items)	Group	N	Mean Rank	Sum of Ranks	Mann-Whitney	Sig.
q.07. Children's ability to perform written commands	3 – 7 years	31	58.00	1798.00	775.000	.037
	8 – 12 years	67	45.57	3053.00	775.000	.037

The null hypothesis is accepted in one of the twelve items within the section of 3 – 7 years against 12 year + teaching experience. These groups hold similar perceptions on the issue of: (a) Children's listening skills

Likewise, the null hypothesis is accepted in eleven out of the twelve items within the section of 8 – 12 years against 12 years + teaching experience. These two groups hold similar perceptions on the following issues:

(a) Reading skills
(b) Ability to comprehend written passages
(c) Ability to comprehend oral speech
(d) Listening skills
(e) Writing
(f) Ability to perform written commands
(g) Ability in computation
(h) Ability to problem solve in mathematics
(i) Quality of knowledge acquired
(j) Quantity of knowledge acquired
(k) Ability to complete investigative tasks

Similarly, the null hypothesis is accepted in eight of the twelve items in this section within the section 0 – 3 years against 12 years + teaching experience. Similar perceptions arose on the issues of:

(a) Ability to comprehend written passages
(b) Oral skills
(c) Ability to comprehend oral speech
(d) Listening skills
(e) Ability to problem solve in mathematics
(f) Quality of knowledge acquired
(g) Quantity of knowledge acquired
(h) Ability to complete investigative tasks

Considering perceptions of children's knowledge in terms of respondents teaching experience the grouping of 0 – 3 years against 8 – 12 years, aligned closely with the null hypothesis accepted in all twelve items. The grouping of 3 – 7 years against 8 – 12 years, accepted the null hypothesis in eleven of the twelve items, rejecting the null hypothesis on the issue of children's ability to perform written commands.

Similarly, the grouping of 8 – 12 years against 12 years +, aligned closely by accepting the null hypothesis in eleven of the twelve items, with differences in perceptions on the issue of children's oral skill.

Noticeably however, the grouping of 3 – 7 years against 12 years +, appear very dissimilar on this overall issue, that is, the null hypothesis is rejected in eleven of the twelve items.

The grouping of 0 – 3 years against 12 years +, resulted in the null hypothesis being accepted on eight of the twelve items within this section.

8.13.1 Summary of Findings

Common perceptions and consensus were found on the issue of:

- Children's listening skills (worsening trend)

8.14 SECTION B – CHILDREN'S AFFECTIVE DOMAIN

<u>*Research Question:*</u> *Has the National Curriculum enhanced the schools' overall ethos in relation to developing the affective domain of the pupils?*

The null hypothesis is accepted in six of the nine items within the grouping of 3 – 7 years against 8 – 12 years teaching experience. The perceptions are similar on the following issues:

(a) Children's conduct in school
(b) Children's respect towards teachers
(c) Co-operation among children

(d) Children's sense of responsibility
(e) Interest for learning
(f) Willingness to volunteer ideas

Table 8.13 : Perceptions in terms of teaching experience on children's affective domain

Item (1 of 9 items)	Group	N	Mean Rank	Sum of Ranks	Mann-Whitney	Sig.
q.13. Children's regular attendance	3 – 7 years	31	63.00	1953.00	620.000	.000
	8 – 12 years	67	43.25	2898.00	620.000	.000
q.17. Willingness to co-operate with teacher	3 – 7 years	31	57.55	1784.00	789.000	.044
	8 – 12 years	67	45.78	3067.00	789.000	.044
q. 20. Children's level of commitment	3 – 7 years	31	57.97	1797.00	776.000	.036
	8 – 12 years	67	45.58	3054.00	776.000	.036

The null hypothesis is accepted in seven of the nine items within the grouping of 0 – 3 years against 8 – 12 years teaching experience. The two groups have similar perceptions on the following:

(a) Children's conduct in school
(b) Children's respect towards teachers
(c) Co-operation among children
(d) Willingness to co-operate with teacher
(e) Interest for learning
(f) Children's level of commitment
(g) Willingness to volunteer ideas

The null hypothesis is accepted in one of the nine items within the grouping of 3 – 7 years against 12 years + teaching experience. These two groups have similar perception on the issue of: Children's respect towards teachers.

Likewise, the null hypothesis is accepted in seven of the nine items within the section of 8 – 12 years against 12 years + teaching experience. Similar perceptions are held on the issues of:

(a) Children's regular attendance
(b) Children's conduct in school
(c) Children's respect towards teachers
(d) Co-operation among children
(e) Willingness to co-operate with teacher
(f) Sense of responsibility
(g) Children's level of commitment

The null hypothesis is accepted in five of the nine items within the section of 0 – 3 years against 12 years + teaching experience. Similar perceptions are held on the issues of:

(a) Children's conduct in school
(b) Children's respect towards teachers
(c) Co-operation among children
(d) Willingness to co-operate with teacher
(e) Willingness to volunteer ideas

Analysing results based upon perceptions of children's affective domain the grouping of 0 – 3 years against 12 years +, accepted the null hypothesis on five of the nine items. Differences occurred on the issue of children's regular attendance, children's sense of responsibility, interest for learning and level of commitment.

The grouping of 3 – 7 year olds against 8 – 12 years, accepted the null hypothesis on six of the nine items, whilst rejecting the null hypothesis on the issues of children's regular attendance, children's willingness to co-operate with the teacher and children's level of commitment . Whilst the grouping of 0 - 3 years against 8 -12 years, accepted the null hypothesis on seven of the nine items, it rejected the null hypothesis on the issues of children's regular attendance and their sense of responsibility.

Whilst the grouping of 8 – 12 years against 12 years +, accepted the null hypothesis on seven of the nine items, differences in perception occurred on the issues of children's interest for learning and children's willingness to volunteer ideas.

Significant differences occur within the grouping of 3 – 7 years against 12 years +, with the null hypothesis being rejected on eight of the nine items.

8.14.1 Summary of Findings

Common perceptions and consensus were found on the issue of:

- Children's respect towards teachers (worsening trend)

8.15 SECTION C – TEACHERS' ATTITUDES

<u>Research Question:</u> In what ways has the National Curriculum affected staff attitudes with respect to staff morale within the teaching profession?

From Table 8.14 the null hypothesis is accepted in one of the nine items within the grouping of 3 – 7 years against 12 years + teaching experience. These groups hold similar perceptions on the issue of:

(a) Teachers attitudes about the importance of pupil assessments.

Table 8.14 : Perceptions in terms of teaching experience on teachers' attitudes

Item (1 of 9 items)	Group	N	Mean Rank	Sum of Ranks	Mann-Whitney	Sig.
q.22. teachers' degree of preparation	3 – 7 years	31	107.48	3332.00	1752.000	.031
	12 + years	148	86.34	12778.00	1752.000	.031
q.23. Teachers' attention to weak students	3 – 7 years	31	110.44	3423.50	1660.500	.013
	12 + years	148	85.72	12686.50	1660.500	.013
q.24. Teachers' attitude towards classroom work	3 – 7 years	31	115.87	3592.00	1492.000	.002
	12 + years	148	84.58	12518.00	1492.000	.002
q.25. Teachers' attitude towards homework	3 – 7 years	31	115.74	3588.00	1496.000	.001
	12 + years	148	84.61	12522.00	1496.000	.001
q.26. Teachers' attitude towards innovations	3 – 7 years	31	109.79	3403.50	1680.500	.016
	12 + years	148	85.85	12706.50	1680.500	.016
q.27. Teachers' attitude towards varying teaching styles	3 – 7 years	31	109.48	3394.00	1690.000	.016
	12 + years	148	85.92	12716.00	1690.000	.016
q.29. Teachers' sense of duty	3 – 7 years	31	123.00	3813.00	1271.000	.000
	12 + years	148	83.09	12297.00	1271.000	.000
q.30. Teachers' interest in pursuing further studies	3 – 7 years	31	112.42	3485.00	1599.000	.007
	12 + years	148	85.30	12625.00	1599.000	.007

The null hypothesis is accepted in four of the nine items within the grouping of 8 – 12 years against 12 years + teaching experience. Similar perceptions are held on the issues of:

(a) Teachers' attention to weak students
(b) Teachers' attitude towards classroom work
(c) Teachers' attitude towards the importance of pupil assessment
(d) Teachers' interest in pursuing further studies

Likewise, the null hypothesis is accepted in eight of the nine items within the grouping of 0 – 3 years against 12 years +. The two groups have similar perceptions on the issues of teachers':

(a) Degree of preparation
(b) Attention to weak students
(c) Attitude towards classroom work
(d) Attitude towards homework
(e) Attitude towards innovations
(f) Attitudes towards varying teaching styles
(g) Towards the importance of pupil assessment
(h) Interest in pursuing further studies

Considering perceptions in terms of teachers' attitudes within the grouping of 0 – 3 years against 8 – 12 years, the null hypothesis is accepted for each of the nine items. This result was repeated with the grouping of 3 – 7 years against 8 – 12 years. Illustrating very close alignment on these items within these groups.

Within the grouping of 8 – 12 years against 12 years +, the null hypothesis was accepted in four of the five items, with differences appearing on aspects of teachers degree of preparation, attitude towards homework, attitude towards innovations, attitude towards varying teaching styles and sense of duty.

The grouping of 0 – 3 years against 12 years +, resulted in the null hypothesis being rejected on one of the nine items in this section, illustrating differences in perception on the issue of teachers sense of duty.

Additionally, within the grouping of 3 – 7 years against 12 years +, the null hypothesis was rejected on eight of the nine items demonstrating alignment on the single issue of staff attitude towards the importance of assessment.

8.15.1 Summary of Findings

Common perceptions and consensus were found on the issue of:

- Teachers attitude towards the importance of assessment (improving trend)

8.16 SECTION D – TEACHERS' SUPPORT MECHANISMS

> <u>Research Question:</u> *Has the National Curriculum created a climate in which staff may call upon colleagues expertise and experience in the form of support mechanisms for delivering the curriculum?*

From Table 8.15 the null hypothesis is accepted in six of the eight items within the grouping of 3 – 7 years against 8 – 12 years teaching experience. These two groups have similar perceptions on the issues of:

(a) Quality of provision of In-service training for teachers
(b) Head-teachers' guidance to teachers
(c) The advice offered by other colleagues
(d) Teachers' knowledge related to quantity of subjects
(e) Teachers' knowledge related to quality of teaching required
(f) Subject co-ordinators support of teachers

Table 8.15 : Perceptions in terms of teaching experience on teachers' support mechanisms

Item (1 of 8 items)	Group	N	Mean Rank	Sum of Ranks	Mann-Whitney	Sig.
q.31. Initial level of newly qualified teachers	3 – 7 years	31	60.55	1877.00	696.000	.007
	8 – 12 years	67	44.39	2974.00	696.000	.007
q.37. Teachers' classroom performance	3 – 7 years	31	57.58	1785.00	788.000	.046
	8 – 12 years	67	45.76	3066.00	788.000	.046

The null hypothesis is accepted in three of the eight items within the grouping of 3 – 7 years against 12 year + teaching experience. Similar perceptions between these two groups on the issues of:

(a) Quality of provision of In-service training for teachers
(b) The advice offered by other colleagues
(c) Teachers knowledge related to quantity of subjects

Similarly, the null hypothesis is accepted in six of the eight items within the grouping of 8 – 12 years against 12 years + teaching experience. The two groups have the same perceptions on the issues of:

(a) Initial level of newly qualified teachers
(b) Quality of provision of In-service training for teachers
(c) The advice offered by colleagues
(d) Teachers' knowledge related to quality of teaching required
(e) Teachers' classroom performance
(f) Subject co-ordinators support of teachers

The null hypothesis is accepted in six of the eight items within the grouping of 0 – 3 years against 12 years + teaching experience. Similar perceptions arose on issues of:

(a) Initial level of newly qualified teachers
(b) Quality of provision of In-Service training for teachers
(c) The advice offered by other colleagues
(d) Teachers' knowledge related to quantity of subjects
(e) Teachers' knowledge related to quality of teaching required
(f) Teachers classroom performance

Considering results based upon teachers support mechanisms with the grouping of 0 – 3 years against 8 – 12 years, the null hypothesis was accepted in all eight items. Within the grouping of 3 – 7 years against 8 – 12 years, the null hypothesis was accepted in six of the eight items, with differences on the issues of the initial level of newly qualified teachers and teachers classroom performance.

The grouping of 0 – 3 years against 12 years +, resulted in the null hypothesis being accepted on six of the eight items. Differences occurred on the issues of head-teachers guidance and subject co-ordinators support for teachers.

Alternatively with the grouping of 8 – 12 years against 12 years +, the null hypothesis was accepted on six of the eight items with differences identified on issues of head-teachers guidance and teachers knowledge related to the quantity of subjects. The grouping of 3 – 7 years against 12 years +, accepted the null hypothesis in three of the eight items.

8.16.1 Summary of Findings

Common perceptions and consensus were found on the issue of:

- Quality and provision of in-service training for teachers (improving trend)
- The advice offered by colleagues (improving trend)

8.17 SECTION E – OBJECTIVES/ OUTCOMES

Research Question: Has the National Curriculum provided clarity in terms of the objectives and outcomes schools are able to set for their mathematics teaching?

From Table 8.16 the null hypothesis is accepted in none of the six items within the grouping of 3 – 7 years against 12 years + teaching experience.

Table 8.16 : Perceptions in terms of teaching experience on objectives/outcomes

Item (1 of 6 items)	Group	N	Mean Rank	Sum of Ranks	Mann-Whitney	Sig.
q. 39. Clarity of your schools objectives in mathematics	3 – 7 years	31	121.65	3771.00	1313.000	.000
	12 + years	148	83.37	12339.00	1313.000	.000
q.40. Clarity of your school's outcomes in mathematics	3 – 7 years	31	113.79	3527.50	1556.500	.002
	12 + years	148	85.02	12582.50	1556.500	.002
q.41. Clarity of objectives in mathematics	3 – 7 years	31	116.40	3608.50	1475.500	.001
	12 + years	148	84.47	12501.50	1475.500	.001
q.42. Clarity of your curriculum outcomes in mathematics	3 – 7 years	31	115.08	3567.50	1516.500	.001
	12 + years	148	84.75	12542.50	1516.500	.001
q.43. The clarity of your objectives in teaching	3 – 7 years	31	107.98	3347.50	1736.500	.020
	12 + years	148	86.23	12762.50	1736.500	.020
q.44. The presence of objectives in all aims	3 – 7 years	31	111.87	3468.00	16116.000	.005
	12 + years	148	85.42	12642.00	16116.000	.005

The null hypothesis is accepted in three of the six items within the grouping of 0 – 3 years against 12 years + teaching experience. Similar perceptions based upon the issues of:

(a) The clarity of objectives in mathematics
(b) The clarity of objectives in teaching
(c) The presence of objectives in all aims

The results from the objectives/outcomes section showed the groupings of 0 – 3 years against 8 – 12 years and 3 – 7 years against 8 – 12 years, accepted the null hypothesis on each of the six items. The group of 8 – 12 years against 12 years +, accepted the null hypothesis on three of the six items. The null hypothesis was rejected on the issues of clarity of school objectives in mathematics, clarity of school outcomes and clarity of curriculum outcomes in mathematics

Significantly, the grouping of 3 – 7 years against 12 years +, rejected the null hypothesis on all six items within the section.

8.17.1 Summary of Findings

Common perceptions and consensus were found on the issue of:

- The clarity of objectives in mathematics (improving trend)
- The clarity of objectives in teaching (improving trend)
- The presence of objectives in all aims (improving trends)

8.18 SECTION F – CURRICULUM CONTENT

Research Question: In relation to the content of the mathematics syllabus, does the National Curriculum provide a viable curriculum?

From Table 8.17 the null hypothesis is accepted in six of the seven items within the grouping of 3 – 7 years against 8 – 12 years teaching experience. Similar perceptions arose on the issues of:

(a) The standard of mathematics throughout Key Stage 2
(b) Time which is allotted to teaching mathematics
(c) The quality of new textbooks published in mathematics
(d) The variety of textbooks used by you in teaching of mathematics
(e) The content of mathematics textbooks used in the classroom
(f) The general presentation of mathematics textbooks used

Table 8.17 : Perceptions in terms of teaching experience on curriculum content

Item (1 of 7 items)	Group	N	Mean Rank	Sum of Ranks	Mann-Whitney	Sig.
Q.45. The quantity of mathematics taught by you	3 – 7 years	31	57.79	1791.50	781.500	.041
	8 – 12 years	67	45.66	3059.50	781.500	.041

The null hypothesis is accepted in one of the seven items within the grouping of 3 – 7 years against 12 years + teaching experience. These groups hold similar perceptions on the issues of:

(b) The variety of textbooks used in teaching mathematics.

Similarly, the null hypothesis is accepted in five of the seven items within the grouping of 8 – 12 years against 12 years + teaching experience. This grouping has similar perceptions based upon the issues of:

(c) The quantity of mathematics taught by you
(d) The quality of new textbooks published on mathematics
(e) The variety of textbooks used by you in teaching mathematics
(f) The content of mathematics textbooks used in your classroom
(g) The general presentation of mathematics textbooks used

The null hypothesis is accepted in six of the seven items within the grouping of 0 – 3 years against 12 years + teaching experience. This group hold similar perceptions on the issues of:

(a) The standard of mathematics taught throughout Key Stage 2
(b) Time which is allotted to teaching mathematics
(c) The quality of new textbooks published on mathematics
(d) The variety of textbooks used in teaching mathematics
(e) The content of mathematics textbooks used in the classroom
(f) The general presentation of mathematics textbooks used by you

Considering the results based upon aspects of curriculum content the group of 0 – 3 years against 8 – 12 years, accepted the null hypothesis in all seven items. The grouping of 3 – 7 years against 8 – 12 years, accepted the null hypothesis in six of the seven items, with differences occurring on the issue of the quantity of mathematics taught.

The grouping of 8 – 12 years against 12 years +, accepted the null hypothesis in five of the seven items. Differences occurred on the issues of the standards of mathematics throughout Key Stage 2 and the time which is allotted to teaching mathematics.

The grouping of 3 – 7 years against 12 years +, resulted in the null hypothesis being rejected on six of the seven items. The grouping of 0 – 3 years against 12 years +, accepted the null hypothesis on six of the seven items, with differences on the issue of the quantity of mathematics taught.

8.18.1 Summary of Findings

Common perceptions and consensus were found on the issue of:

- The variety of textbooks used in the teaching of mathematics (improving trend)

8.19 SECTION G – CURRICULUM METHODOLOGY

Research Question: *Has the National Curriculum provided a catalyst for the development and refinement of curriculum methodology?*

From Table 8.18 the null hypothesis is accepted in one of the eight items within the grouping of 3 – 7 years against 12 years + teaching experience. We see the groups here have similar perceptions on the issue of:

(a) Matching of mathematics taught with children's ability level.

Table 8.18 : Perceptions in terms of teaching experience on curriculum methodology

Item (1 of 8 items)	Group	N	Mean Rank	Sum of Ranks	Mann-Whitney	Sig.
q.52. Your use of teaching aids	3 – 7 years	31	108.35	3359.00	1725.000	.018
	12 + years	148	86.16	12751.00	1725.000	.018
q.54. Atmosphere in classrooms to enable learning	3 – 7 years	31	119.97	3719.00	1365.000	.000
	12 + years	148	83.72	12391.00	1365.000	.000
q.55. Appropriateness of classroom organisation	3 – 7 years	31	111.40	3453.50	1630.500	.005
	12 + years	148	85.52	12656.50	1630.500	.005
q.56. Information given to teachers about innovations	3 – 7 years	31	112.66	3492.50	1591.500	.004
	12 + years	148	85.25	12617.50	1591.500	.004
q.57. The introduction of new methods within your classroom	3 – 7 years	31	113.27	3511.50	1572.500	.003
	12 + years	148	85.13	12598.50	1572.500	.003
q.58. Teachers' attitude towards the introduction of new methods	3 – 7 years	31	107.53	3333.50	1758.500	.030
	12 + years	148	86.33	12776.50	1758.500	.030
q.59. Methodological recommendations offered in mathematical texts	3 – 7 years	31	114.98	3564.50	1519.500	.002
	12 + years	148	84.77	12545.50	1519.500	.002

Likewise, the null hypothesis is accepted in three of the eight items within the grouping of 8 – 12 years against 12 years + teaching experience. These groups have similar perceptions on the issues of:

(a) Use of teaching aids
(b) Matching of mathematics taught with children's ability level
(c) Teachers' attitude towards the introduction of new methods

The null hypothesis is accepted in six of the eight items within the grouping of 0 – 3 years against 12 years + teaching experience. The groups have similar perceptions on the issues of:

(a) Use of teaching aids
(b) Matching of mathematics throughout Key Stage 2
(c) Appropriateness of classroom organisation
(d) Information given to teachers about innovations
(e) The introduction of new methods within classrooms
(f) Teachers attitude towards the introduction of new methods

The results based upon curriculum methodology showed for the group of 0 – 3 years against 8 – 12 years, the null hypothesis was accepted in all eight items. This result was replicated by the group of 3 – 7 years against 8 – 12 years.

However, the grouping of 8 – 12 years against 12 years +, resulted in the null hypothesis being accepted in three of the eight items. Differences occurred on issues of atmosphere in the classroom to enable learning, appropriateness of classroom organisation, information given to teachers about innovations, introduction of new methods within your classroom and methodological recommendation offered in textbooks.

The groups of 3 – 7 years against 12 years +, resulted in the null hypothesis being accepted on one of the eight items in the section.

The grouping of 0 –3 years against 12 years +, accepted the null hypothesis on six of the eight items, with differences on the issues of the atmosphere in the classroom and methodological recommendations offered in mathematical textbooks.

8.19.1 Summary of Findings

Common perceptions and consensus were found on the issue of:

- Matching mathematics taught with children's abilities (improving trend)

8.20 SECTION H – SCHOOL/ COMMUNITY

<u>Research Question:</u> *Has the National Curriculum provided benefits in terms of improved relationships between the school and the wider external community?*

From Table 8.19 the null hypothesis is accepted in two of the five items within the grouping of 3 – 7 years against 12 years + teaching experience. These groups have similar perceptions on the issues of:

(a) Communities respect for school
(b) The influence of school within the community

Table 8.19 : Perceptions in terms of teaching experience on school/ community relationships

Item (1 of 5 items)	Group	N	Mean Rank	Sum of Ranks	Mann-Whitney	Sig.
q. 60. Relations between teachers and parents	3 – 7 years	31	115.66	3585.50	1498.500	.001
	12 + years	148	84.63	12524.50	1498.500	.001
q.61. Parents' respect for teachers	3 – 7 years	31	110.90	3438.00	1646.000	.010
	12 + years	148	85.62	12672.00	1646.000	.010
q.62. The co-operation of the community with the school	3 – 7 years	31	109.77	3403.00	1681.000	.010
	12 + years	148	85.86	12707.00	1681.000	.010

The null hypothesis is accepted in three of the five items within the grouping of 8 – 12 years against 12 years + teaching experience. The groups have similar perceptions on the issues of:

(a) The co-operation of the community with the school
(b) Communities respect for school
(c) The influence of school within the community

Similarly, the null hypothesis is accepted in four of the five items within the grouping of 0 – 3 years against 12 years + teaching experience. These groups have similar perceptions on the issues of:

(a) Parents' respect for teachers
(b) The co-operation of the community with the school
(c) Communities respect for school
(d) The influence of school within the community

Considering perceptions of the relationships between school and community the groupings of 0 – 3 years against 8 – 12 years, resulted in the null hypothesis being accepted in all five items. The groupings of 3 – 7 years against 8 – 12 years, also resulted in the null hypothesis being accepted in all five items.

The grouping of 8 – 12 years against 12 years +, resulted in the null hypothesis being accepted in three of the five items. Differences arose on the issues of relations between teachers and parents and parents respect for teachers.

The grouping of 3 – 7 years against 12 years +, resulted in the null hypothesis being accepted in two of the five items. Differences were noted on issues of relations between teachers and parents, parents respect for teachers and the co-operation of the community with the school.

The grouping of 0 – 3 years against 12 years +, accepted the null hypothesis in five of the six items, differences occurred on the issue of relations between teachers and parents.

8.20.1 Summary of Findings

Common perceptions and consensus were found on the issue of:

- Communities respect for school (worsening trend)
- The influence of school within the community (worsening trend)

8.21 SECTION I – MATHEMATICAL TEXTBOOKS

Research Question: *Has the National Curriculum initiated development and improvements in relation to mathematical textbooks available for delivering the subject?*

From Table 8.20 the null hypothesis is accepted in ten of the twelve items within the grouping of 3 – 7 years against 8 – 12 years teaching experience. These groups have similar perceptions on the issues of:

(a) The quality of graphs, pictures, tables and diagrams used
(b) The number of tasks provided for children to solve
(c) Provides a content that meets the children's needs
(d) Restricts my teaching methods
(e) Do not follow the logical sequence of the subject
(f) Are adequate for children's self-study
(g) Present examples, activities and exercises relevant to the children's experience
(h) Greatly assist in lesson preparation
(i) Do not include material in the form of motivation or enrichment topics
(j) Are accompanied by Teachers' Manuals used regularly

Table 8.20 : Perception in terms of teaching experience on mathematical textbooks

Item (1 of 12 items)	Group	N	Mean Rank	Sum of Ranks	Mann-Whitney	Sig.
q.67. Are too abstract for the children's age they are produced for	3 – 7 years	31	57.98	1797.50	775.500	.029
	8 – 12 years	67	45.57	3053.50	775.500	.029
q.70. Present mathematical content accurately	3 – 7 years	31	58.02	1798.50	774.500	.020
	8 – 12 years	67	45.56	3052.50	774.500	.020

The null hypothesis is accepted in two of the twelve items within the grouping of 3 – 7 years against 12 years + teaching experience. This group have similar perceptions on the issues of:

(a) Textbooks greatly assist in lesson preparation
(b) Are accompanied by Teachers' Manuals used regularly

Similarly, the null hypothesis is accepted in nine of the twelve items in this section 8 – 12 years against 12 years + teaching experience. The groups have a similar perception of the following issues:

(a) The quality of graphs, pictures, tables and diagrams used
(b) The number of tasks provided for children to solve
(c) Restricts my teaching methods
(d) Present mathematical content accurately
(e) Do not follow the logical sequence of the subject
(f) Are adequate for children's self-study
(g) Greatly assist in lesson preparation
(h) Are accompanied by Teachers' Manuals used regularly
(i) Are too abstract for the children's age they are produced for

The null hypothesis is accepted in two of the twelve items within the grouping of 0 – 3 years against 12 years + teaching experience. The groups have similar perceptions on the following issues:

(a) Greatly assist me in lesson preparation
(b) Textbooks are accompanied by Teachers' Manuals used regularly

Analysing the results based upon perceptions of the usage of mathematical textbooks within schools, the grouping of 0 – 3 years against 8 – 12 years, accepted the null hypothesis in all twelve items. The grouping of 3 – 7 years against 8 – 12 years, accepted the null hypothesis in ten of the twelve items. Differences appeared on issues of whether the textbooks are too abstract for the children's age they are produced for and whether they present mathematical content accurately.

The grouping of 8 – 12 years against 12 years +, resulted in the null hypothesis being accepted in nine of the twelve items in this section. It was rejected on the issues of whether the textbooks provides a content that meets the children's needs, whether they present examples, activities and exercises relevant to the children's experience and also if the textbook includes material in the form of motivation or enrichment topics. The grouping of 3 – 7 years against 12 years +, resulted with the null hypothesis being accepted in two of the twelve items.

The grouping of 0 – 3 years against 12 years +, resulted in the null hypothesis being rejected on ten of the twelve items within the section.

8.21.1 Summary of Findings

Common perceptions and consensus were found on the issue of:

- Textbooks greatly assist in lesson preparation (improving trend)
- Textbooks are accompanied with teachers' manuals I use regularly (improving trend)

8.22 SECTION J – PROPORTION OF TEACHING TIME

Research Question: Has the National Curriculum provided clarity in relation to the adoption of specific subject teaching methodologies within schools?

From Table 8.21 the null hypothesis is accepted in three of the ten items within the grouping of 3 – 7 years against 12 years + teaching experience. This group has similar perceptions on the issues of:

(a) Problem solving
(b) Discovery Approaches
(c) Practical Activity

Table 8.21 : Perceptions in terms of teaching experience on use of teaching time

Item (1 of 10 items)	Group	N	Mean Rank	Sum of Ranks	Mann-Whitney	Sig.
q.77. Lecture Method	3 – 7 years	31	122.92	3810.50	1273.500	.000
	12 + years	148	83.10	12299.50	1273.500	.000
q.78. Demonstration/ illustration	3 – 7 years	31	118.45	3672.00	1412.000	.000
	12 + years	148	84.04	12438.00	1412.000	.000
q. 79. Discussion	3 – 7 years	31	110.19	3416.00	1668.000	.012
	12 + years	148	85.77	12694.00	1668.000	.012
q.80. Drill and Practice	3 – 7 years	31	121.00	3751.00	1333.000	.000
	12 + years	148	83.51	12359.00	1333.000	.000
q.83. The expository Style	3 – 7 years	31	114.55	3551.00	1533.000	.002
	12 + years	148	84.86	12559.00	1533.000	.002
q.84. Investigational work	3 – 7 years	31	110.02	3410.50	1673.500	.012
	12 + years	148	85.81	12699.50	1673.500	.012
q.86. Programmed learning	3 – 7 years	31	124.13	3848.00	1236.000	.000
	12 + years	148	82.85	12262.00	1236.000	.000

The null hypothesis is accepted in four of the ten items within the grouping of 8 – 12 years against 12 years + teaching experience. This group has similar perceptions on the issues of:

(a) Problem Solving
(b) Discovery Approaches
(c) Investigational Work
(d) Practical Activity

Similarly, the null hypothesis is accepted in six of the ten items within the grouping of 0 – 3 years against 12 years + teaching experience. Similar perceptions arose on the issues of:

(a) Demonstration/Illustration
(b) Discussion
(c) Problem Solving
(d) Discovery Approaches
(e) Investigational Work
(f) Practical Activity

Considering perceptions of use of teaching time, the grouping of 0 – 3 years against 8 – 12 years, accepted the null hypothesis in six of the ten items in this section. The grouping of 3 – 7 years against 8 – 12 years, resulted in the null hypothesis being accepted in all ten items.

The grouping of 8 – 12 years against 12 years +, resulted in the null hypothesis being accepted in four of the ten items. Similarly, the grouping of 3 – 7 years against 12 + years, resulted in the null hypothesis being accepted in three of the ten items.

8.22.1 Summary of Findings

Common perceptions and consensus were found on the issue of:

- Problem solving (improving trend)
- Discovery approaches (improving trend)
- Practical activity (improving trend)

8.23 SECTION K – GENERAL QUESTION

Research Question: *Has the National Curriculum improved the chances of raising standards in primary education?*

The null hypothesis was accepted by all groups on this issue within this section.

8.23.1 Summary of Findings

Common perceptions and consensus was found on this issue (improving trend).

CHAPTER 9

COMPARATIVE ANALYSIS BASED UPON QUALIFICATION RELATED FACTORS

9.1 INTRODUCTION

Considering groupings based upon the qualifications of respondents, the results were analysed in terms of groupings of:

Certificate in Education against Master's Degree (Cert.Ed./Master's)
Post Graduate Certificate in Education against Master's Degree (PGCE/Master's)
First Degree against Master's
First Degree against Master's Degree (First Degree/Master's)
First Degree against Post Graduate Certificate in Education (First Degree/PGCE)
Certificate in Education against First Degree (Cert. Ed/First Degree)

Significantly, for the grouping of Cert. Ed against First Degree (the largest grouping in terms of number of respondents) the null hypothesis was rejected in all eighty seven items. This clearly indicates a significant difference in perception and attitude between staff holding a Certificate in Education and staff holding a First Degree.

9.2 SECTION A – CHILDREN'S KNOWLEDGE

> <u>Research Question:</u> *Has the National Curriculum provided benefits in terms of the knowledge gained by pupils?*

From Table 9.1 the null hypothesis is accepted in six of the twelve items within the grouping of First Degree against Master's Degree. This group has similar perceptions on the issues of children's:

(a) Reading skills
(b) Oral skills
(c) Ability to comprehend oral speech
(d) Ability to problem solve in mathematics
(e) Quality of knowledge acquired by children
(f) Ability to complete investigative tasks

Table 9.1 Perceptions in terms of qualifications on children's knowledge

Item (1 of 12 items)	Group	N	Mean Rank	Sum of Ranks	Mann-Whitney	Sig.
q.2. Children's ability to comprehend written passages	First Degree	95	71.63	6805.00	1175.000	.004
	Master's Degree	36	51.14	1841.00	1175.000	.004
q.5. Children's listening skills	First Degree	95	69.94	6644.00	1336.000	.046
	Master's Degree	36	55.61	2002.00	1336.000	.046
q.6. Children's writing	First Degree	95	70.97	6742.50	1237.500	.012
	Master's Degree	36	52.88	1903.50	1237.500	.012
q.07. Children's ability to perform written commands	First Degree	95	71.15	6759.00	1221.000	.008
	Master's Degree	36	52.42	1887.00	1221.000	.008
q.08. Children's ability in computation	First Degree	95	70.96	6741.00	1239.000	.012
	Master's Degree	36	52.92	1905.00	1239.000	.012
q.11. The quantity of knowledge acquired by children	First Degree	95	70.69	6715.50	1264.500	.017
	Master's Degree	36	53.63	1930.50	1264.500	.017

Similarly, the null hypothesis is accepted in ten of the twelve items within the grouping of PGCE against Master's Degree. This group has similar perceptions on the issues of:

(a) Reading skills
(b) Ability to comprehend written passages
(c) Ability to comprehend oral speech
(d) Writing
(e) Ability to perform written commands
(f) Ability in computation
(g) Ability to problem solve in mathematics
(h) Quality of knowledge acquired
(i) Quantity of knowledge that is acquired by children
(j) Ability to complete investigative tasks

The null hypothesis is accepted in nine of the twelve items within the grouping of Cert. Ed. Against Master's Degree. Similar perceptions arose on the issues of:

(a) Reading skills
(b) Ability to comprehend written passages
(c) Listening skills
(d) Writing
(e) Ability to perform written commands
(f) Ability in computation
(g) Ability to problem solve in mathematics
(h) Quality of knowledge acquired
(i) Quantity of knowledge that is acquired by children

The null hypothesis is accepted in none of the twelve items within the grouping of First Degree against PGCE.

Considering perceptions based upon children's knowledge the grouping of PGCE/ Master's, accepted the null hypothesis on ten of the twelve items, with differences based upon the issues of children's oral and listening skills.

The grouping of Cert. Ed./PGCE, resulted in the null hypothesis being accepted on all twelve items. Considering the grouping of Cert. Ed./Master's Degree the null hypothesis was accepted in nine of the twelve items. Differences occurred on issues of children's oral skills, ability to comprehend oral speech and the ability to complete investigative tasks.

The grouping of First Degree/Master's resulted in the null hypothesis being accepted on six of the twelve items in the section. The grouping of the First Degree/PGCE resulted in a considerable difference with the null hypothesis being rejected on all twelve items.

9.2.1 Summary of Findings

Common perceptions and consensus were found on the issue of:

- Reading skills (worsening trend)

- Ability to problem solve in mathematics (improving trend)
- Quality of knowledge acquired by children (improving trend)

9.3 SECTION B – CHILDREN'S AFFECTIVE DOMAIN

Research Question: Has the National Curriculum enhanced the schools' overall ethos in relation to developing the affective domain of the pupils?

From Table 9.2 the null hypothesis is accepted in four of the nine items within the grouping of First Degree against Master's Degree. This group have the same perceptions on the issues of children's:

(a) Regular attendance
(b) Co-operation among children
(c) Willingness to co-operate with teacher
(d) Willingness to volunteer ideas

Table 9.2 : Perceptions in terms of qualifications on children's affective domain

Item (1 of 9 items)	Group	N	Mean Rank	Sum of Ranks	Mann-Whitney	Sig.
q.14. Children's conduct in school	First Degree	95	70.62	6709.00	1271.000	.017
	Master's Degree	36	53.81	1937.00	1271.000	.017
q.15. Children's respect towards teachers	First Degree	95	69.86	6637.00	1343.000	.046
	Master's Degree	36	55.81	2009.00	1343.000	.046
q.18. Children's sense of responsibility	First Degree	95	69.88	6639.00	1341.000	.045
	Master's Degree	36	55.75	2007.00	1341.000	.045
q.19. Children's interest for learning	First Degree	95	70.11	6660.00	1320.000	.034
	Master's Degree	36	55.17	1986.00	1320.000	.034
q. 20. Children's level of commitment	First Degree	95	70.76	6722.00	1258.000	.013
	Master's Degree	36	53.44	1924.00	1258.000	.013

The null hypothesis is accepted in eight of the nine items within the grouping of PGCE against Master's Degree. This group has similar perceptions on the issues on children's:

(a) Conduct in school
(b) Respect towards teachers
(c) Co-operation among children
(d) Willingness to co-operate with teacher
(e) Sense of responsibility
(f) Interest for learning
(g) Level of commitment
(h) Willingness to volunteer ideas

Similarly, the null hypothesis is accepted in eight of the nine items within the grouping of Cert.Ed. against PGCE. This group has the same perceptions on the issues of children's:

(a) Conduct in school
(b) Respect towards teachers
(c) Co-operation among children
(d) Willingness to co-operate with teacher
(e) Sense of responsibility
(f) Interest for learning
(g) Level of commitment
(h) Willingness to volunteer ideas

The null hypothesis is accepted in six of the nine items within the grouping of Cert. Ed. against Master's Degree. This group has similar perceptions on the issues of children's:

a) Conduct in school
b) Respect towards teachers
c) Willingness to co-operate with teacher
d) Sense of responsibility
e) Interest for learning
f) Level of commitment

The null hypothesis is accepted in three of the nine items within the grouping of First Degree against PGCE. Similar perceptions arose on issues of children's:

(a) Regular attendance
(b) Sense of responsibility
(c) Willingness to volunteer ideas

Considering the results based upon children's affective domain, the grouping of PGCE/Master's resulted in the null hypothesis being accepted in eight of the nine items. Difference was seen on the issue of children's attendance. The grouping of Cert. Ed/PGCE repeated this result.

However the grouping of Cert. Ed./Master's resulted in the null hypothesis being accepted in six of the nine items, with significant differences occurring on issues of children's regular attendance, co-operation among children and children's willingness to volunteer ideas.

The grouping of First Degree/Master's produced the result of the null hypothesis being accepted in four of the nine items, with significant differences based upon children's conduct, respect, responsibility, interest and levels of commitment within school.

The grouping of First Degree/PGCE resulted in the null hypothesis being accepted in three of the nine items.

9.4 SECTION C – TEACHERS' ATTITUDES

<u>Research Question:</u> *in what ways has the National Curriculum affected staff attitudes with respect to staff morale within the teaching profession?*

From Table 9.3 the null hypothesis is accepted in three of the nine items within the grouping of First Degree against Master's Degree. This group has similar perceptions on the issues of teachers':

(a) Attitudes towards classroom work
(b) Attitude towards homework
(c) Sense of duty

Table 9.3 : Perceptions in terms of qualifications on teachers' attitudes

Item (1 of 9 items)	Group	N	Mean Rank	Sum of Ranks	Mann-Whitney	Sig.
q.22. teachers' degree of preparation	First Degree	95	72.03	6842.50	1137.500	.002
	Master's Degree	36	50.10	1803.50	1137.500	.002
q.23. Teachers' attention to weak students	First Degree	95	69.86	6637.00	1343.000	.049
	Master's Degree	36	55.81	2009.00	1343.000	.049
q.26. Teachers' attitude towards innovations	First Degree	95	71.04	6749.00	1231.000	.011
	Master's Degree	36	52.69	1897.00	1231.000	.011
q.27. Teachers' attitude towards varying teaching styles	First Degree	95	70.28	6676.50	1303.500	.029
	Master's Degree	36	54.71	1969.50	1303.500	.029
q.28. Teachers attitude towards the importance of pupil assessment	First Degree	9	70.31	6679.00	1301.000	.028
	Master's Degree	36	54.64	1967.00	1301.000	.028
q.30. Teachers' interest in pursuing further studies	First Degree	95	71.35	6778.50	1201.500	.007
	Master's Degree	36	51.88	1867.50	1201.500	.007

The null hypothesis is accepted in seven of the nine items within the grouping of Cert.Ed. against PGCE. Similar perceptions arose on the issues of teachers' attitudes on:

(a) Degree of preparation
(b) Attention to weak students
(c) Towards homework
(d) Towards innovations
(e) Varying teaching styles
(f) The importance of pupil assessment
(g) Interest in pursuing further studies

The null hypothesis is accepted in five of the nine items within the grouping of Cert. Ed. against Master's Degree. Similar perceptions were evident on the issues of teachers' attitudes on:

a) Degree of preparation
b) Attention to weak students
c) Towards innovations
d) The importance of pupil assessment
e) Interest in pursuing further studies

The null hypothesis is accepted in two of the nine items within the grouping of First Degree against Master's Degree. This group has similar perceptions on the issues of teachers':

(a) Attitudes towards classroom work
(b) Sense of duty

Considering responses to teachers attitudes the grouping of PGCE/Master's resulted in the null hypothesis being accepted in all items. The grouping of Cert. Ed./PGCE resulted in the null hypothesis being accepted in seven of the nine items, with differences occurring on aspects of teachers attitudes towards classroom work and teachers sense of duty. The grouping of Cert. Ed./Master's resulted in the null hypothesis being accepted in five of the nine items. With differences occurring on issues of teachers attitudes towards classroom work, homework, varying teaching styles and sense of duty.

The grouping of First Degree/Master's resulted in the null hypothesis being accepted in three of the nine items, demonstrating considerable differences within this grouping. Similarly, the grouping of First Degree/PGCE resulted in the null hypothesis in only two of the nine items within this section.

9.5 SECTION D – TEACHERS' SUPPORT MECHANISMS

Research Question: *Has the National Curriculum created a climate in which staff may call upon colleagues expertise and experience in the form of support mechanisms for delivering the curriculum?*

From Table 9.4 the null hypothesis is accepted in three of the eight items within the grouping of First Degree against Master's Degree. We see this group has similar perceptions on the issues of:

(a) Initial level of newly qualified teachers
(b) Head-teachers guidance to teachers
(c) Teachers' classroom performance

Table 9.4 : Perceptions in terms of qualifications on teacher support mechanisms

Item (1 of 8 items)	Group	N	Mean Rank	Sum of Ranks	Mann-Whitney	Sig.
q.32. Quality of provision of in-service training for teachers	First Degree	95	70.86	6731.50	1248.500	.012
	Master's Degree	36	53.18	1914.50	1248.500	.012
q.34. The advice offered by other colleagues	First Degree	95	70.99	6744.50	1235.500	.009
	Master's Degree	36	52.82	1901.50	1235.500	.009
q.35. Teachers' knowledge related to quantity of subjects	First Degree	95	70.36	6684.50	1295.500	.026
	Master's Degree	36	54.49	1961.50	1295.500	.026
q.36. Teachers' knowledge related to quality of subjects	First Degree	95	70.55	6702.00	1278.000	.020
	Master's Degree	36	54.00	1944.00	1278.000	.020
q.38. Subject co-ordinators support for teachers	First Degree	95	71.05	6749.50	1230.500	.010
	Master's Degree	36	52.68	1896.50	1230.500	.010

The null hypothesis is accepted in seven of the eight items within the grouping of PGCE against Master's Degree. Similar perceptions arose on the issues of:

(a) Initial level of newly qualified teachers'
(b) Quality of provision of In-service training for teachers
(c) Head-teachers guidance to teachers
(d) The advice offered by other colleagues
(e) Teachers' knowledge related to quality of teaching required
(f) Teachers' classroom performance
(g) Subject co-ordinators support of teachers

Likewise, the null hypothesis is accepted in five of the eight items within the grouping of Cert.Ed. against PGCE. We see this group has similar perceptions on the issues of:

a) Quality of provision of In-service training for teachers
b) The advice offered by other colleagues
c) Teachers' knowledge related to quantity of subjects
d) Teachers' knowledge related to quality of teaching required
e) Subject co-ordinators support of teachers

The null hypothesis is accepted in three of the eight items within the grouping of Cert. Ed. against Master's Degree. This group has similar perceptions on the issues of:

(a) Quality of provision of In-service training for teachers
(b) The advice offered by other colleagues
(c) Subject co-ordinators support for teachers

The null hypothesis is accepted in none of the eight items within the grouping of First Degree against PGCE.

The grouping of First Degree/PGCE resulted in the null hypothesis being rejected in all eight items, demonstrating significant differences in attitude and perception on these issues within this section.

The grouping of First Degree/Master's reported the null hypothesis being accepted on three of the eight items.

Considering responses to perceptions of teachers support mechanisms the grouping of PGCE/Master's resulted in the null hypothesis being accepted on seven of the eight items, it being rejected on the issue of teachers' knowledge related to quantity of subjects. The grouping of the Cert. Ed./PGCE resulted in the null hypothesis being accepted on five of the eight items with differences occurring on levels of newly qualified teachers, head-teachers guidance to teachers and teachers classroom performance.

The grouping of Cert. Ed./Master's resulted in the null hypothesis being accepted on three of the eight items. Significant differences occurred on issues of initial levels of newly qualified teachers, head-teachers' occurred on areas of quality of in-service training, advice of colleagues, knowledge relating to quantity and quality of subjects along with subject co-ordinators support for teachers.

9.6 SECTION E – OBJECTIVES/ OUTCOMES

> Research Question: *Has the National Curriculum provided clarity in terms of the objectives and outcomes schools are able to set for their mathematics teaching?*

From Table 9.5 the null hypothesis is accepted in five of the six items within the grouping of First Degree against Master's Degree. We see this group has similar perceptions on the issues of:

(a) The clarity of schools objectives in mathematics
(b) The clarity of objectives in mathematics
(c) The clarity of curriculum outcomes in mathematics
(d) The clarity of objectives in teaching
(e) The presence of objectives in all aims

Table 9.5 : Perceptions in terms of qualifications on objectives/ outcomes

Item (1 of 6 items)	Group	N	Mean Rank	Sum of Ranks	Mann-Whitney	Sig.
q.40. Clarity of your school's outcomes in mathematics	First Degree	95	69.98	6648.00	1332.000	.038
	Master's Degree	36	55.50	1998.00	1332.000	.038

The null hypothesis is accepted in four of the six items within the grouping of Cert. Ed. against PGCE. Similar perceptions arose on the issues of:

a) The clarity of schools objectives in mathematics
b) The clarity of schools outcomes in mathematics
c) The clarity of curriculum outcomes in mathematics
d) The clarity of objectives in teaching

The null hypothesis is accepted in none of the six items within the grouping of Cert. Ed. against Master's Degree.

Similarly, the null hypothesis is accepted in one of the six items within the grouping of First Degree against PGCE, that is: The clarity of objectives in mathematics

Considering responses to objectives/outcomes the grouping of PGCE/Master's resulted in the null hypothesis being accepted in all seven items. The grouping of the Cert. Ed./PGCE resulted in the null hypothesis being accepted in four of the six items, with differences on the issues of clarity of objectives in mathematics, and the presence of objectives in all aims. The grouping of First Degree/Master's resulted in the null hypothesis being accepted in five of the six items in the section.

The grouping of First Degree/PGCE resulted in the null hypothesis being accepted in only one of the six items, demonstrating a considerable difference within the grouping. Similarly, significant differences resulted between the grouping of Cert. Ed./Master's, where in all six items, the null hypothesis was rejected.

9.6.1 Summary of Findings

Common perceptions and consensus were found on the issue of:

- The clarity of schools objectives in mathematics (improving trend)

9.7 SECTION F – CURRICULUM CONTENT

> Research Question: *In relation to the content of the mathematics syllabus, does the National Curriculum provide a viable curriculum?*

From Table 9.6 the null hypothesis is accepted in two of the seven items within the grouping of First Degree against Master's Degree. This group has similar perceptions on the issues of:

(a) The standard of mathematics throughout Key Stage 2
(b) The general presentation of mathematics textbooks used

Table 9.6 : Perceptions in terms of qualifications on curriculum content

Item (1 of 7 items)	Group	N	Mean Rank	Sum of Ranks	Mann-Whitney	Sig.
Q.45. The quantity of mathematics taught by you	First Degree	95	70.09	6659.00	1321.000	.038
	Master's Degree	36	55.19	1987.00	1321.000	.038
q.47. Time which is allotted to teaching mathematics	First Degree	95	70.08	6658.00	1322.000	.038
	Master's Degree	36	55.22	1988.00	1322.000	.038
q.48. The quality of new textbooks published on mathematics	First Degree	95	71.51	6793.50	1186.500	.004
	Master's Degree	36	51.46	1852.50	1186.500	.004
q.49. The variety of textbooks used by you in teaching of mathematics	First Degree	95	71.31	6774.00	1206.000	.007
	Master's Degree	36	52.00	1872.00	1206.000	.007
q. 50. The content of mathematics textbooks used in your classroom	First Degree	95	71.57	6799.50	1180.500	.004
	Master's Degree	36	51.29	1846.50	1180.500	.004

The null hypothesis is accepted in six of the seven items within the grouping of PGCE against Master's Degree. Here we see this grouping has similar perceptions on the issues of:

(a) The quantity of mathematics taught
(b) Time which is allotted to teaching mathematics
(c) The quality of new textbooks published on mathematics
(d) The variety of textbooks used in the teaching of mathematics
(e) The content of mathematics textbooks used in classrooms
(f) The general presentation of mathematics textbooks used

The null hypothesis is accepted in four of the seven items within the grouping of Cert. Ed. against Master's Degree. This group have similar perceptions on the issues of:

(a) The quantity of mathematics taught
(b) The quality of new textbooks published on mathematics
(c) The variety of textbooks used in the teaching of mathematics
(d) The content of mathematics textbooks used in classrooms

However, the null hypothesis is accepted in none of the seven items within the grouping of First Degree against PGCE.

Considering responses to curriculum content the grouping of PGCE/Master's resulted in the null hypothesis being accepted in six of the seven items, with differences on the issue of the standard of mathematics throughout Key Stage 2. The grouping of Cert. Ed./PGCE saw a similar alignment within the group with the null hypothesis being accepted on all seven items.

In contrast to this, the groupings of Cert. Ed./Master's, First Degree/Master's and First Degree/PGCE, resulted in significant differences being expressed. That is, the null hypothesis was rejected in four of the seven, five of the seven and seven out of seven items respectively. Significant differences arose on issues of quantity and standard of mathematics taught, time allotted to teaching mathematics and aspects of the textbooks used in the teaching of mathematics.

9.8 SECTION G – CURRICULUM METHODOLOGY

<u>Research Question:</u> *Has the National Curriculum provided a catalyst for the development and refinement of curriculum methodology?*

From Table 9.7 the null hypothesis is accepted in four of the eight items within the grouping of First Degree against Master's Degree. This group has similar perceptions on the issues of:

(a) Use of teaching aids
(b) Matching of mathematics taught with children's ability level
(c) Atmosphere in classrooms to enable learning
(d) Appropriateness of classroom organisation

Table 9.7 : Perceptions in terms of qualifications on curriculum methodology

Item (1 of 8 items)	Group	N	Mean Rank	Sum of Ranks	Mann-Whitney	Sig.
q.56. Information given to teachers about innovations	First Degree	95	70.57	6704.00	1276.000	.017
	Master's Degree	36	53.94	1942.00	1276.000	.017
q.57. The introduction of new methods within your classroom	First Degree	95	70.29	6677.50	1302.500	.028
	Master's Degree	36	54.68	1968.50	1302.500	.028
q.58. Teachers' attitude towards the introduction of new methods	First Degree	95	70.38	6686.00	1294.000	.025
	Master's Degree	36	54.44	1960.00	1294.000	.025
q.59. Methodological recommendations offered in mathematical texts	First Degree	95	70.16	6665.50	1314.500	.031
	Master's Degree	36	55.01	1908.50	1314.500	.031

The null hypothesis is accepted in seven of the eight items within the grouping of Cert. Ed. against PGCE. This group has similar perceptions on the issues of:

(a) Use of teaching aids
(b) Matching of mathematics taught with children's ability level
(c) Appropriateness of classroom organisation
(d) Information given to teachers about innovations
(e) The introduction of new methods within the classroom
(f) Teachers' attitudes towards the introduction of new methods
(g) Methodological recommendations offered in mathematical texts

The null hypothesis is accepted in five of the eight items within the grouping of Cert. Ed. against Master's Degree. Similar perceptions arose on the issues of:

(a) Use of teaching aids
(b) Matching of mathematics taught with children's ability level
(c) Appropriateness of classroom organisation
(d) The introduction of new methods within the classroom
(e) Methodological recommendations offered in mathematical texts

The null hypothesis is accepted in two of the eight items within the grouping of First Degree against PGCE. This group has similar perceptions on the issues of:

(a) Atmosphere in classrooms to enable learning
(b) Methodological recommendations offered in mathematical texts

Considering responses to curriculum methodology the grouping of PGCE/Master's resulted in the null hypothesis being accepted on all eight items. Similarly, the grouping of Cert. Ed./PGCE resulted in the null hypothesis being accepted on seven of the eight items, with difference occurring on the issue of the atmosphere in classrooms to enable learning.

The grouping of Cert. Ed./Master's resulted in acceptance of the null hypothesis in five of the eight cases, occurring on issues of atmosphere within classrooms, information about innovations and attitude towards the introduction of new methods. Similarly, the groupings of First Degree/Master's resulted in the acceptance of the null hypothesis in four of the eight items, with the addition of the issue of methodological recommendations offered in mathematical texts.

The grouping of First Degree/PGCE resulted in the null hypothesis being accepted on two of the eight items, indicating significant differences within this group.

9.9 SECTION H – SCHOOL/ COMMUNITY

Research Question: *Has the National Curriculum provided benefits in terms of improved relationships between the school and the wider external community?*

From Table 9.8 the null hypothesis is accepted in two of the five items within the grouping of First Degree against Master's Degree. This group has similar perceptions on the issues of:

(a) Relations between teachers and parents
(b) The co-operation of the community with the school

Table 9.8 : Perceptions in terms of qualifications in terms of school/ community relationships

Item (1 of 5 items)	Group	N	Mean Rank	Sum of Ranks	Mann-Whitney	Sig.
q.61. Parents' respect for teachers	First Degree	95	69.96	6646.50	1333.500	.040
	Master's Degree	36	55.54	1999.50	1333.500	.040
q.63. Community's respect for school	First Degree	95	70.08	6658.00	1322.000	.040
	Master's Degree	36	55.22	1988.00	1322.000	.040
q.64. The influence of school within the community	First Degree	95	70.36	6684.00	1296.000	.023
	Master's Degree	36	54.50	1962.00	1296.000	.023

The null hypothesis is accepted in three of the five items within the grouping of PGCE against Master's Degree. This group has similar perceptions on the issues of:

(a) Relations between teachers and parents
(b) Parents respect for teachers
(c) Communities respect for school

The null hypothesis is accepted in four of the five items within the grouping of Cert. Ed. against PGCE. This group has similar perceptions on the issues of:

(a) Parents respect for teachers
(b) The co-operation of the community with the school
(c) Communities respect for school
(d) The influence of the school within the community

The null hypothesis is accepted in two of the five items within the grouping of Cert. Ed. against Master's Degree. This group has similar perceptions on the issues of:

(a) Parents' respect for teachers
(b) Communities respect for school

The null hypothesis is accepted in one of the five items within the grouping of First Degree against PGCE. This group has similar perception on the issue of:

(a) Relations between teachers and parents

Considering responses to school/community relationships, the grouping of PGCE/Master's resulted in the null hypothesis being accepted in three of the five items, with differences relating to the co-operation of the community with the school and influence of the school within the community. Similarly, the grouping of Cert. Ed./PGCE resulted in the null hypothesis being accepted in four of the five items, with differences occurring on the issues of relations between teachers and parents.

Additionally, the groupings of Cert. Ed./Master's and First Degree/ Master's, resulted in the null hypothesis being accepted in two of the five items. Differences were based upon issues of relations between teachers and parents, co-operation between community and school and the influence of the school within the community.

The grouping of First Degree/PGCE resulted in the null hypothesis being accepted in one of the five items in this section.

9.10 SECTION I – MATHEMATICAL TEXTBOOKS

> Research Question: *Has the National Curriculum initiated development and improvements in relation to mathematical textbooks available for delivering the subject?*

From Table 9.9 the null hypothesis is accepted in nine of the twelve items within the grouping of First Degree against Master's Degree. This group has similar perceptions on the issues of:

(a) The quality of graphs, pictures, tables and diagrams used
(b) The number of tasks provided for children to solve
(c) Are too abstract for the children's age produced for
(d) Restricts my teaching methods
(e) Do not follow the logical sequence of the subject
(f) Are adequate for children's self-study
(g) Present examples, activities and exercises relevant to the children's experience
(h) Greatly assist in lesson preparation
(i) Are accompanied by Teachers' Manuals used regularly

Table 9.9 : Perceptions in terms of qualifications on mathematical textbooks

Item (1 of 12 items)	Group	N	Mean Rank	Sum of Ranks	Mann-Whitney	Sig.
q.68. Provides a content that meets the children's needs	First Degree	95	70.34	6682.50	1297.500	.024
	Master's Degree	36	54.54	1963.50	1297.500	.024
q.70. Present mathematical content accurately	First Degree	95	69.82	6632.50	1347.500	.044
	Master's Degree	36	55.93	2013.50	1347.500	.044
q.75. Do not include material in the form of motivation or enrichment topics	First Degree	95	69.96	6646.50	1333.500	.036
	Master's Degree	36	55.54	1999.50	1333.500	.036

The null hypothesis is accepted in eleven of the twelve items within the grouping of PGCE against Master's. Similar perceptions exist on the issues of:

(a) The quality of graphs, pictures, tables and diagrams used
(b) The number of tasks provided for children to solve
(c) Are too abstract for the children's age produced for
(d) Provides a content that meets the children's needs
(e) Present mathematical content accurately
(f) Do not follow the logical sequence of the subject
(g) Are adequate for children's self-study
(h) Present examples, activities and exercises relevant to the children's experience
(i) Greatly assist in lesson preparation
(j) Do not include material in the form of motivation or enrichment topics
(k) Are accompanied by Teachers' Manuals used regularly

However, the null hypothesis is accepted in nine of the twelve items within the grouping of Cert. Ed. against PGCE. Similar perceptions exist on the issues of:

(a) The quality of graphs, pictures, tables and diagrams used
(b) The number of tasks provided for children to solve
(c) Are too abstract for the children's age produced for

(d) Do not follow the logical sequence of the subject
(e) Are adequate for children's self-study
(f) Present examples, activities and exercises relevant to the children's experience
(g) Greatly assist in lesson preparation
(h) Do not include material in the form of motivation or enrichment topics
(i) Are accompanied by Teachers' Manuals used regularly

The null hypothesis is accepted in four of the twelve items within the grouping of Cert. Ed against Master's Degree. Similar perceptions exist on the issues of:

(a) The quality of graphs, pictures, tables and diagrams used;
(b) The number of tasks provided for children to solve;
(c) Greatly assist in lesson preparation:
(d) Are accompanied by Teachers' Manuals used regularly.

The null hypothesis is accepted in two of the twelve items within the grouping of First Degree against PGCE. Here similar perceptions exist on the issues of:

(a) The number of tasks provided for children to solve
(b) Present mathematical content accurately

Considering responses to the category of mathematical textbooks, the grouping of PGCE/Master's resulted in the null hypothesis being accepted in eleven of the twelve items, with differences occurring on the issue of textbooks restricting teaching methods.

The grouping of Cert. Ed./PGCE and First Degree/Master's resulted in the similar result of the null hypothesis being accepted in nine of the twelve items, with rejections occurring on the issues of providing a content for children's needs, present mathematical content accurately, restricts teaching methods and does not include material in the form of motivation or enrichment topics.

The grouping of Cert. Ed./Master's and First Degree/PGCE produced similar differences with the null hypothesis being accepted in four of the twelve and two of the twelve items respectively.

9.10.1 Summary of Findings

Common perceptions and consensus were found on the issue of:

- The number of tasks provided for children to solve (improving trend)

9.11 SECTION J – PROPORTION OF TEACHING TIME

Research Question: *Has the National Curriculum provided clarity in relation to the adoption of specific subject teaching methodologies within schools?*

The null hypothesis is accepted in five of the ten items within the grouping of First Degree against Master's Degree. Similar perceptions exist on the issues of:

(a) Lecture method
(b) Discussion
(c) Drill and practice
(d) The expository style
(e) Programmed learning

Table 9.10 : Perceptions in terms of qualifications in use of teaching time

Item (1 of 10 items)	Group	N	Mean Rank	Sum of Ranks	Mann-Whitney	Sig.
q.78. Demonstration/ illustration	First Degree	95	69.75	6626.00	1354.000	.048
	Master's Degree	36	56.11	2020.00	1354.000	.048
q.81. Problem Solving	First Degree	95	70.64	6710.50	1269.500	.017
	Master's Degree	36	53.76	1935.50	1269.500	.017
q.82. Discovery Approaches	First Degree	95	72.37	6875.00	1105.000	.001
	Master's Degree	36	49.19	1771.00	1105.000	.001
q.84. Investigational work	First Degree	95	71.76	6817.50	1162.500	.003
	Master's Degree	36	50.79	1828.50	1162.500	.003
q.85. Practical Activity	First Degree	95	69.99	6649.00	1331.000	.041
	Master's Degree	36	55.47	1997.00	1331.000	.041

The null hypothesis is accepted in nine of the ten items within the grouping of PGCE against Master's. Similar perceptions exist on the issues of:

(a) Lecture method
(b) Demonstration/Illustration
(c) Discussion
(d) Drill and Practice
(e) Discovery Approaches
(f) The expository style
(g) Investigational work
(h) Practical activity
(i) Programmed learning

The null hypothesis is accepted in seven of the ten items within the grouping of Cert. Ed. against PGCE. Similar perceptions exist on the issues of:

(a) Demonstration/Illustration;
(b) Discussion;
(c) Problem solving;

(d) Discovery Approaches;
(e) The expository style;
(f) Investigational work;
(g) Practical activity.

Likewise, the null hypothesis is accepted in four of the ten items within the grouping of Cert. Ed. against Master's Degree. Similar perceptions arose on the issues of:

(a) Problem Solving;
(b) Discovery Approaches;
(c) Investigational work;
(d) Practical activity;

The null hypothesis is accepted in two of the ten items within the grouping of First Degree against PGCE. There is a similar perception on the issues of:

(a) Lecture method
(b) Programmed learning

Considering responses on the issue of use of teaching time the grouping of PGCE/Master's resulted in the acceptance of the null hypothesis on nine of the ten items, with rejection on the issue of problem solving. Similarly, the grouping of Cert. Ed./PGCE accepted the null hypothesis on seven out of ten items, rejecting on issues of lecture method, drill and practice and programmed learning.

The grouping of First Degree/Master's resulted in acceptance of the null hypothesis on five of the ten items. The grouping of Cert. Ed/Master's accepted the null hypothesis on four of the ten items in this section.

Additionally, the grouping of First Degree/PGCE resulted in considerable differences within the group, with the null hypothesis accepted on two of the ten items.

9.12 SECTION K – GENERAL QUESTION

<u>Research Question:</u> *Has the National Curriculum improved the chances of raising standards in primary education?*

From Table 9.11 the null hypothesis is accepted in none of the items within the grouping of First Degree against Master's Degree.

Table 9.11 : Perceptions in terms of qualifications on chances of raising standards

Item (1 of 1 items)	Group	N	Mean Rank	Sum of Ranks	Mann-Whitney	Sig.
q.87. NC improved chances of raising standards	First Degree	95	69.91	6641.00	1339.000	.048
	Master's Degree	36	55.69	2005.00	1339.000	.048

From Table 9.12 the null hypothesis is accepted in none of the one items within the grouping of PGCE against Master's Degree.

Table 9.12 : Perceptions in terms of qualifications on chances of raising standards

Item (1 of 1 items)	Group	N	Mean Rank	Sum of Ranks	Mann-Whitney	Sig.
q.87. NC improved chances of raising standards	PGCE	28	26.50	742.00	336.000	.017
	Master's	36	37.17	1338.00	336.000	.017

From Table 9.13 the null hypothesis is accepted in none of the one items within the grouping of First Degree against PGCE.

Table 9.13 : Perceptions in terms of qualifications on raising standards

Item (1 of 1 items)	Group	N	Mean Rank	Sum of Ranks	Mann-Whitney	Sig.
q.87. NC improved chances of raising standards	First Degree	95	68.76	6532.00	688.000	.000
	PGCE	28	39.07	1094.00	688.000	.000

Considering the issue of raising standards, the groupings PGCE/ Master's, First Degree/ Master's and First Degree/ PGCE, rejected the null hypothesis indicating a difference on this item within these groups.

RESULTS BASED UPON ATTENDANCE ON IN-SERVICE MATHEMATICS COURSES

9.13 SECTION B – CHILDREN'S AFFECTIVE DOMAIN

<u>Research Question:</u> *Has the National Curriculum enhanced the schools' overall ethos in relation to developing the affective domain of the pupils?*

From Table 9.14 the null hypothesis is accepted in eight of the nine items within the grouping of 1 – 5 courses against 6 – 10 courses attended. This group has similar perceptions on the issues on children's:

(i) Conduct in school

(j) Respect towards teachers

(k) Co-operation among children;

(l) Willingness to co-operate with teacher;

(m) Sense of responsibility;

(n) Interest for learning;

(o) Level of commitment;

(p) Willingness to volunteer ideas.

Table 9.14 : Perceptions in terms of number of courses attended on children's affective domain

Item (1 of 9 items)	Group	N	Mean Rank	Sum of Ranks	Mann-Whitney	Sig.
q.13. Children's regular attendance	1 – 5 courses	167	87.33	14583.50	397.500	.031
	6 – 10 courses	7	91.64	641.50	397.500	.031

The null hypothesis was accepted on all other issues within this Section.

CHAPTER 10

CONCLUSIONS

10.1 INTRODUCTION

The conclusions will be presented in two sections based around the results of the two research elements of this study and the extensive literature review undertaken in Chapters 1 to 3. In Section 10.2 implications of the empirical data investigated in Chapter 5 (i.e., the local study element of the project) will be discussed. Conclusions based upon the questionnaire survey reported in Chapters 6, 7, 8 and 9 (i.e., the national survey) will be presented in Section 10.3. Commentary and discussion based upon these findings and the literature review are included throughout the chapter. Clearly, because of the close relationship and nature of the material investigated, some of the elements discussed within a given section will interact with, and reinforce assertions made in other sections of the study.

10.2 THE LOCAL STUDY

It is noticeable that the numbers of children on role within the sample are falling and experience considerable fluctuation in frequency year on year. Such a trend if sustained would impact heavily upon schools, particularly in relation to the current formula funding method of allocation of budget to schools. This could result in changes in staff/pupils ratios which would affect organisation of classes within schools and adversely affect the implementation of the National Curriculum with specific reference to raising standards.

The scores achieved on the test instrument used ranged from 4 and 50 inclusive (maximum possible = 50), with 70.5% of children obtaining 25 or more marks out of 50. The mean score was 29.39 with a standard deviation of 8.15. This indicates a good standard of achievement in mathematics throughout the period. Improvement in mathematical achievement is clearly evident, particularly in the years 1992, 1993 and 1994, that is, in the years post introduction of the National Curriculum.

Year on year results were considered to establish if any significant differences in mathematical achievement occurred between years. Results of the Wilcoxon rank sum test indicated that 23 of the 66 combinations resulted in no significant differences in achievement between years. Conversely, 43 of the 66 year group combinations showed significant differences in mathematical achievement between years. In particular, the years 1992, 1993 and 1994 were statistically different from other years in the period investigated. This allows us to refute the suggestion that standards are falling in mathematical achievement. Indeed there is considerable improvement in the years 1992 – 1994, possibly resulting from the introduction of the National Curriculum beginning to impact upon the classroom situation.

Considering results relating to pre/post introduction periods of the national curriculum, that is, the years 1983 to 1988 against 1989 to 1994, the mean score of 29.27 (SD 7.85) for the years 1983 to 1988 was comparable with the mean score of 29.52 (SD 8.48) for the years 1989 to 1994. This resulted in very little variation in overall mathematical achievement between the two categories being evident. This finding was further confirmed with the application of the t-test on these two categories. Consequently, such a comparison does not allow us to draw conclusions relating to the introduction of the National Curriculum. However the fact remains there is noticeable overall improvements during the years 1992 to 1994.

Comparison of achievement between genders during the six years pre/post introduction of the National Curriculum, showed no difference between boys and girls in relation to the mean scores achieved by the two groups. This was supported by the application of the t-test to these categories, and confirmed that there was no significant difference in achievement between boys and girls in the six years before, or the six years after the introduction of the National Curriculum.

Considering year on year comparisons of achievement between genders, three years 1987, 1992 and 1994 show particular differences in achievement between boys and girls. The levels of achievement for boys and girls for the remaining nine years are comparable. Additionally, for the twelve year period, 28.9% (109 out of 377) boys and 30.1% (117 out of 389) scored less than half marks in the test, that is below 25 out of 50. Clearly, boys and girls overall achieve well on this test. The mean score (boys) of 29.47 (SD 8.09) is comparable with the mean score (girls) 29.30 (SD 8.21), suggesting little difference in achievement exists between genders throughout this period. However overall, there is a difference in mathematical achievement between the genders as identified by the Wilcoxon test when applied to the groupings of boys against girls. Additionally, achievement between genders within years indicates that there were no differences between boys and girls in each of the twelve years considered.

The results of the children's overall mathematical performance in the four mathematical areas considered, that is, computational skills, recall of basic facts, application of concepts and skills and understanding of basic concepts, in relation to successful outcomes are shown in Table 10.1:

Table 10.1 Comparison of performance in four mathematical areas

	% score	ranking
Computational Skills	82.6%	1st
Recall of basic facts	80.9%	2nd
Application of concepts and skills	64%	3rd
Understanding of basic concepts	77%	3rd

Clearly the most successful element for the children overall was that of computational skills (82.6% success), whilst the element of application of concepts and skills (64% success) caused the most difficulties. This continues to be highlighted at a national level within the UK where AT1 (Using and Applying mathematics) appears to be the element of greatest cause for concern throughout. The t-test was applied to investigate any significant differences in performance of the cohort within each of these four elements of mathematics. It was concluded there was no significant differences in children's overall performance within the area of computational skills. However, significant differences did occur within the cohort in the mathematical elements of recall of basic facts, application of concepts and skills, and understanding of basic concepts.

The performance of the children, when considered in terms of successful outcomes between genders in each of these four mathematical areas, is shown in Table 10.2:

Table 10.2 : Comparison of performance in the four mathematical areas by gender

	Boys	Ranking	Girls	Ranking
Computational skills	85%	2nd	80.3%	1st
Recall of basic facts	86.9%	1st	75.3%	2nd
Application of concepts & skills	69.4%	4th	59.2%	4th
Understanding of basic concepts	81.1%	3rd	73.2%	3rd

It can be seen that the boys out-perform the girls in each mathematical area considered. Indeed within the element of computational skills, boys have higher success rates in 9 of the 11 questions. In recall of basic facts, boys have higher success rates in 7 of the 8 questions. On application of concepts and skills boys achieved higher success rates in all 13 questions. On understanding of basic concepts boys achieved higher success rates in 10 of the 18 questions. However, the application of Chi-square tests found that within all four mathematical elements, no significant differences are identifiable between the performance of boys and girls. Consequently it is concluded, on average, boys and girls did not perform differently within any of the four mathematical elements.

Chi-square tests were used to determine if there were any significant differences between boys and girls' performance in each of the 50 individual questions on the test instrument. It was found that there was a significant difference in mathematical achievement between boys and girls in 11 of the 50 questions on the test instrument, with boys outperforming the girls in each of these 11 questions (1 of computation skills, 3 of recall of basic facts, 1 of application of concepts and skills, and 6 of understanding of basic concepts).

Considering the children's responses overall to the test items in terms of the mathematical areas of Number, Measure, Shape and Pictorial Representation the success facility indicators were ranked in the order shown in Table 10.3:

Table 10.3 : Success facility within topic area

	Total Score	Rank
Number	77.51%	1st
Measure	74.55%	3rd
Shape	75.15%	2nd
Pictorial Representation	70.97%	4th

It is seen that overall the children were more successful on number items within the test instrument and found items based upon pictorial representation the most difficult. Similarly, considering the success facilities in relation to gender, the ranks shown in Table 10.4 were obtained:

Table 10.4 : Success facility within topic areas by gender

	Boys	Ranking	Girls	Ranking
Number	81.30%	1st	73.96%	1st
Measure	81.23%	2nd	68.29%	3rd
Shape	80.00%	3rd	70.60%	2nd
Pictorial Representation	73.89%	4th	68.23%	4th

In a balanced mathematics syllabus, pupils need to become proficient in basic skills, develop conceptual understanding and become adept at problem solving. All three areas are important and none should be neglected or under-emphasised. Lessons and activities that delve deeply into all three aspects will, over time, constitute a balanced program. Balance does not imply that set amounts of time be allocated for basic skills, conceptual understanding and problem solving. At times, pupils might be involved in lessons or activities which focus upon one aspect, while at other times lessons and activities may focus upon two or all three aspects.

Basic skills are those skills that all pupils should use routinely and automatically. As pupils learn a basic skill, it is necessary that over time they understand the reasoning behind the skill, that understanding is attached to the skill. As a basic skill is practised sufficiently and used frequently, pupils commit these skills to memory. If a pupil occasionally forgets a part of a basic skill, the pupils understanding of the reasoning behind the skill serves as a 'map' to recall or recreate the skill.

Basic skills are important at all levels of mathematics and each level has its own set of basic skills that must be learned. Computational skills, for example, are an important building block in basic skills, and each strand of mathematics has its set of basic skills. In the development and maintenance of basic skills there are several factors to consider. Pupils must practice skills in order to become proficient. The practice should be varied and should be included in classroom activities and homework. Teachers, pupils and parents should realise that pupils must spend substantial time and effort to really learn a skill.

Basic skills are developed over time, and they increase in depth and complexity over the years. For example, the ability to interpret information that is given graphically begins at Key Stage 1 and extends to more sophisticated graphs as pupils pass through the different key stages. To maintain skills, pupils must use them frequently throughout their school years. For example, once students have learned a particular operation, they need to use it again and again in algebraic and geometric problems. Pupils more readily learn a skill when they see how it will be useful or are intrigued by a problem that requires the skill.

Pupils who have conceptual understanding make sense of mathematics. They know not only how to apply skills, but when to apply them, and why they are being applied. Pupils with conceptual understanding see relationships between skills and problem solving as well as amongst mathematical concepts. They see the structure and logic of mathematics, use mathematics more flexibly and appropriately, and are able to recall or adapt rules because they see the larger pattern. Conceptual understanding enables pupils to apply their basic skills in situations and problems they haven't necessarily encountered before.

Mathematical concepts are at the heart of mathematics and are important at all levels of study. For example, during the initial stages of Key Stage 2 pupils should understand that one way of thinking about multiplication is as repeated addition, one interpretation of fractions is as part of the whole, measurement of distances is fundamentally different from measurement of area, and more reliable information about the probability of an event generally comes from a larger sample. As pupils progress through the key stage, they should understand the concepts of proportional relationships that underlie similarity and congruence, that the real number line has properties of a continuum and so on.

Problem solving involves applying skills, understandings and experiences to resolve new or perplexing situations. Solving problems challenges pupils to apply their conceptual understanding in a new complex situation, to exercise their basic skills and to see mathematics as a way of finding answers to some of the problems that occur outside the classroom. Pupils grow in their ability and persistence in problem solving by virtue of extensive experience in solving problems at a variety of levels of difficulty and at every level in their mathematical development. Problems vary in size or complexity, some may be solved in just a few minutes, while others take days, weeks or even longer. Many problems that first appear novel will be practised in various forms until they become routine.

Real problems, mathematical or otherwise, are not usually stated in precise or easy to identify form. More often they are embedded in vague descriptions of puzzling or complex situations. The ability to identify potential mathematical relationships that could aid in the resolution of these situations is an important basic problem solving skill. Identification of basic assumptions, directly or indirectly made in the description of the situation, extraneous information, missing information, mathematical hypotheses or conjectures, and mathematical questions that arise from various mathematical procedures (graphs, tables, diagrams, computations etc), are important both in the formulation and analysis of such situations. Identification of patterns and a search for connections to known mathematical structures are also important strategies in the analysis of problem situations.

The solution of problems that have been formulated from a description of the situation, discovered in the process of using a variety of analysis strategies, conducting an investigation, or in the search for connections to known mathematical structures requires a wide variety of basic and technical mathematical skills. For example, pupils need computation skills, skills related to graphing, knowledge of geometric relationships and measurement concepts and the analysis of graphical information and data. A mathematics program should include a substantial number of 'ready to solve' exercises that are designed specifically to develop and reinforce these basic technical skills. It is also important to develop the skill of estimating solutions. Sometimes when solutions are compared to estimates, significant oversights in the adequacy of the method to solve the situation are revealed.

Additionally, pupils need to verify that their solution to the underlying mathematical problem is correct, that their strategy is appropriate and that their solution makes sense in the context of the original problem. Pupils must deduce generalisations as a result of solving a problem and seek connections to other problems.

10.3 THE NATIONAL SURVEY

Conclusions presented here are based largely upon the findings reported within Chapters 6, 7, 8 and 9. They are presented in the form of responses to the research questions identified within this study, that is, those questions posed in Section 4.3.2 of the Research Methodology.

The objectives for mathematics education outlined within the framework of the National Curriculum are highly ambitious. Achieving these objectives requires a solid mathematics curriculum, competent and knowledgeable teachers who can integrate assessment within a range of teaching methodologies, education policies that enhance and support learning, classrooms with access to modern resources and technology and a thorough commitment to both opportunity and excellence. The challenges are enormous and meeting them is essential. Our pupils deserve and require the best mathematics education possible, one which will ultimately enable them to fulfil personal ambitions and career goals in an ever-changing world. All interested parties must work together to create mathematics classrooms where pupils of varied backgrounds and abilities work with expert teachers, learning key mathematical ideas with understanding, in environments that are challenging and supportive.

10.3.1 Section A: Children's Knowledge

Research Question: Has the National Curriculum provided benefits in terms of the knowledge gained by pupils?

General Conclusions

The National Curriculum has had an effect upon children's knowledge.

Respondents perceive the situation in eight of the twelve items to be unchanged or improved (see Table 6.12). A worsening of the situation is judged to have occurred in the areas of children's reading, listening and comprehension skills. Encouragingly, the elements of problem solving, ability to complete investigative tasks as well as the quality and quantity of knowledge acquired by children is perceived as having improved considerably. In terms of mathematics within Key Stage 2, findings are very encouraging regarding the current status and also for further, future improvements of standards within schools. Table 10.5 summarises elements of perceived improvement in children's knowledge, as indicated in Appendix 19, where a mean score greater than 4 indicates an improvement in the situation:

Table 10.5 Perceived improvement in children's knowledge

Item (6 of 12 items)
q.03. Children's oral skills
q.04. Children's ability to comprehend oral speech
q.09. The ability to problem solve in mathematics
q.10. The quality of knowledge acquired by children
q.11. The quantity of knowledge acquired by children
q.12. The ability to complete investigative tasks

Role Related Conclusions

Common perceptions and consensus were found on the issues of:

- Children's reading skills (worsening trend)
- Children's ability to comprehend written passages (improving trend)
- Children's ability to comprehend oral speech (improving trend)
- Children's ability in computation (no change in situation)
- The ability to complete investigative tasks (improving trend)

Person Related Conclusions

Differences in perception between males and females occurred on all twelve items in this section.

Common perceptions and consensus within the teaching experience groupings were found on the issue of:

- Children's listening skills (worsening trend)

Qualification Related Conclusion

Common perceptions and consensus were found on the issue of:

- Reading skills (worsening trend)
- Ability to problem solve in mathematics (improving trend)
- Quality of knowledge acquired by children (improving trend)

The objectives of school mathematics in the National Curriculum is based on pupils' learning mathematics with understanding. Unfortunately, learning mathematics without understanding has long been a common outcome of school mathematics teaching. In fact, learning without understanding has been a persistent problem since at least the 1960s, and it has been the subject of much discussion and research. In the twenty-first century, all pupils should be expected to understand and be able to apply the mathematics they are taught.

In recent decades, educational research on the learning of complex subjects such as mathematics has established the important role that conceptual understanding plays in the knowledge and activity of persons who are considered proficient in that area. Being proficient in a complex domain entails the ability to use knowledge flexibly, applying what is learned in one setting appropriately in another. The alliance of factual knowledge, procedural proficiency, and conceptual understanding makes all three components usable in powerful ways. Pupils who memorise facts or procedures without understanding often are not sure when or how to use what they know.

The requirements for the workplace include flexibility in reasoning about and using quantitative information. Conceptual understanding is an essential component of the knowledge needed to deal with novel problems and settings. Moreover, as judgements change about the facts or procedures that are essential in an increasingly technological world, conceptual understanding becomes even more important. For example, most of the arithmetic and algebraic procedures long viewed as being at the heart of the school mathematics curriculum can now be performed with handheld calculators. Thus, more attention can be given to understanding the number concepts and the modelling procedures used in solving problems.

A major aim of school mathematics is to create autonomous learners, and learning with understanding supports this goal. Pupils learn more and learn better when they can take control of their learning by defining their goals and monitoring their progress. When challenged with appropriately chosen tasks, pupils become confident in their ability to tackle difficult problems, eager to work things out on their own, flexible in exploring mathematical ideas and trying alternative solution paths, and willing to persevere. Effective learners recognise the importance of reflecting on their thinking and learning from their mistakes.

The kind of experiences teachers provide clearly plays a major role in determining the extent and quality of pupils' learning. Pupils' knowledge and understanding of mathematical ideas are built throughout their school life, but if they actively engage in tasks and experiences designed to deepen and connect their knowledge there are clear benefits. Learning with understanding can be further enhanced by classroom interaction as pupils propose mathematical ideas and conjectures, learn to evaluate their own thinking and that of others, and develop mathematical reasoning skills which support their knowledge. The results of the questionnaire survey indicate that pupils' conceptual understanding is likely to be enhanced not only because of the quality and quantity of knowledge that is being acquired, but also because of improvements in oral comprehension, problem solving and investigative skills. These are clearly very positive benefits of the implementation of the National Curriculum in our schools.

10.3.2 Section B: Children's Affective Domain

<u>Research Question:</u> *Has the National Curriculum enhanced the schools' overall ethos in relation to developing the affective domain of the pupils?*

General Conclusions

The National Curriculum has had an effect upon the children's affective domain.

It is concluded that there has been an improvement in two elements within this section as a result of the introduction of the National Curriculum (see Table 6.15). Items identified as relating to a worsening situation are those of children's conduct in school, respect for teachers, sense of responsibility and interest, along with commitment to learning within school. Table 10.6 summarises the perceived improvement in the child's affective domain, as indicated in Appendix 19, where a mean score greater than 4 indicates an improvement in the situation.

Table 10.6 : Perceived improvement children's affective domain

Item (2 of 9 items)
q.13. Children's regular attendance
q.21. Children's willingness to volunteer ideas

Role Related Conclusions

Common perceptions and consensus were found on the issues of:

- Children's conduct in school (worsening trend)
- Children's respect towards teachers (worsening trend)
- Co-operation among children (worsening trend)
- Willingness to co-operate with teacher (worsening trend)
- Children's sense of responsibility (worsening trend)
- Children's willingness to volunteer ideas (improving trend)

Person Related Conclusions

Differences between males and females occurred on all nine items in this section.

In the groupings relating to teaching experience, common perceptions and consensus were found on the issue of:

- Children's respect towards teachers (worsening trend)

One of the essential ingredients for individual pupils to succeed in any activity is the basic requirement that the individual concerned wants to achieve and be successful at that particular activity. Hence the basic requirement for pupils to understand and realise the importance of learning mathematics. We live in a time of extraordinary and accelerating change. New knowledge, tools and ways of doing and communicating mathematics continue to emerge and evolve, the need to understand and be able to use mathematics in everyday life and in the workplace has never been greater and will continue to increase. Therefore pupils requiring this 'need' to learn mathematics may be directed to four fundamental reasons, that is, mathematics for life, as part of cultural heritage, for the workplace and for the scientific and technical community.

To develop and foster positive attitudes towards mathematics pupils need to know mathematics can be personally satisfying and empowering. The underpinnings of daily life are increasingly mathematical and technological. For example, making purchasing decisions require a considerable quantitative knowledge and application. Just as the mathematics needed within daily lifestyles has increased dramatically, so too has the level of mathematical thinking and problem solving needed in the workplace.

In this changing world, pupils need to understand those who can do mathematics will have significantly enhanced opportunities and options for shaping their futures. Hence there is need to develop positive attitudes towards the subject, constantly challenging the assumption that mathematics is only for the select few. All children should have the opportunity and the support necessary to learn significant mathematics with depth and understanding, establishing the ethos that there is no conflict between opportunity and excellence.

The National Curriculum calls for a common foundation of mathematics to be learned by all pupils. This however, does not imply that all pupils are alike. That is, pupils continue to display different talents, abilities, achievements, needs and interests in mathematics. However all pupils must have access to the highest quality mathematics teaching programs. Therefore, pupils who have a deep interest in pursuing mathematics within their careers must have their talents and interests engaged, similarly, pupils with special educational needs must have the opportunities and support they require to achieve a substantial understanding of important mathematics.

A major area of policy that affects pupils' access to mathematics education is "setting," which is the long-term placement of pupils in classes, courses, or groups that offer different curricula according to the pupils' perceived mathematical abilities. Historically, setting has consistently resulted in a select group of pupils being enrolled in mathematics courses that challenge and enrich them while others are placed in mathematics classes that concentrate on remediation or do not offer significant mathematical substance. As a result, these pupils are unable to experience a full program of school mathematics across the range of content areas. The National Curriculum takes a strong stance. All pupils should have a common foundation of challenging mathematics, whether those pupils will enter the workplace after secondary school or pursue further study in mathematics and science.

Learning mathematics with understanding requires consistent access to high-quality mathematics teaching. A significant challenge to realising the objectives portrayed in the National Curriculum is disengagement. Too many pupils disengage from school mathematics, which creates a serious problem for their teachers. Pupils may become uninvolved for various reasons. Many, for example, find it difficult to sustain the motivation and effort required to learn what can be a challenging school subject.

Learning mathematics is stimulating, rewarding, and at times difficult. Pupils can do their part by engaging seriously with the material and striving to make mathematical connections that will support their learning. If pupils are committed to communicating their understandings clearly to their teachers, then teachers are better able to plan teaching and respond to pupils' difficulties. Productive communication requires that pupils record and revise their thinking and learn to ask good questions as part of learning mathematics. The results of this research suggest that there is work to do in improving pupils' attitudes towards the school in general and towards the learning and application of mathematics in particular.

10.3.3 Section C: Teachers' Attitudes

Research Question: *In what ways has the National Curriculum affected staff attitudes with respect to staff morale within the teaching profession?*

General Conclusions

The introduction of the National Curriculum has had an effect upon teacher's attitudes (See Table 6.17).

Questionnaire responses indicated considerable improvement in attitudes towards a range of issues surrounding the National Curriculum framework. The one item which yielded an unfavourable result relates to teachers' interest in pursuing further studies. Table 10.7 summarises the perceived improvement in teachers' attitudes, as indicated in Appendix 19, where a mean score greater than 4 indicates an improvement in the situation.

Table 10.7 : Perceived improvement in teachers' attitudes

Item (8 of 9 items)
q.22. Teachers' degree of preparation
q.23. Teachers' attention to weak students
q.24. Teachers' attitude towards classroom work
q.25. Teachers' attitude towards homework
q.26. Teachers' attitude towards innovations
q.27. Teachers' attitude towards varying teaching styles
q.28. Teachers attitude towards the importance of pupil assessment
q.29. Teachers' sense of duty

Role Related Conclusions

Common perceptions and consensus were found on the issues of:

- Teachers' attention to weak students (improving trend)
- Teachers' attitude towards classroom work (improving trend)
- Teachers' attitude towards homework (improving trend)
- Teachers' attitude towards innovations (improving trend)
- Teachers' attitude towards varying teaching styles (improving trend)
- Teachers' attitude towards the importance of pupil assessment (improving trend)
- Teachers' sense of duty (improving trend)
- Teachers' interest in pursuing further studies (worsening trend)

Person Related Conclusions

Differences between males and females occurred on all nine items in this section.

In the groupings relating to teaching experience common perceptions and consensus were found on the issue of:

- Teachers attitude towards the importance of assessment (improving trend)

Making the objectives of the National Curriculum a reality for all pupils within Key Stage 2 is both an essential goal and a significant challenge. Achieving this goal requires raising expectations for pupils learning, developing effective methods of supporting the learning of mathematics by all pupils, and providing pupils and teachers with the resources they need. All pupils, regardless of their personal characteristics, backgrounds, or physical challenges, must have opportunities to study, and support to learn, mathematics. This opportunity however does not mean that every pupil should receive identical instruction; instead, it demands that reasonable and appropriate accommodations be made as needed to promote access and achievement for all pupils.

All pupils need access within each year to a coherent, challenging mathematics curriculum taught by competent and well-supported mathematics teachers. Moreover, pupils' learning and achievement should be assessed and reported in ways that point to areas requiring prompt additional attention. The vision of these opportunities in mathematics education challenges a pervasive societal belief that only some pupils may be capable of learning mathematics. This belief, in contrast to the equally pervasive view that all pupils can and should learn to read and write in English, could lead to low expectations for too many pupils. Low expectations are especially problematic because pupils who live in poverty, pupils with disabilities and females, have traditionally been far more likely than their counterparts in other demographic groups to be the victims of low expectations. Expectations must be raised, mathematics can and must be learned by all pupils.

These opportunities demands that high expectations for mathematics learning be communicated in words and deeds to all pupils. Teachers communicate expectations in their interactions with pupils during classroom teaching, through their comments on pupils' work, when assigning pupils to teaching groups, through the presence or absence of consistent support for pupils who are striving for high levels of achievement, and in their contacts with significant adults in a pupils life. These actions, along with decisions and actions taken outside the classroom to assign pupils to different classes or curricula, also determine pupils' opportunities to learn and influence pupils' beliefs about their own abilities to succeed in mathematics. Schools have an obligation to ensure that all pupils participate in a strong teaching program that supports their mathematics learning. High expectations can be achieved in part with teaching programs that are interesting for pupils and help them see the importance and utility of continued mathematical study for their own futures.

Higher expectations are necessary, but they are not sufficient alone to accomplish the objective of raising standards within school. All pupils should have access to an excellent mathematics program that provides solid support for their learning and is responsive to their prior knowledge, intellectual strengths, and personal interests. Some pupils may need further assistance to meet high mathematics expectations.

Pupils with disabilities may need increased time to complete assignments, or they may benefit from the use of oral rather than written assessments. Pupils who have difficulty in mathematics may need additional resources, such as additional homework, peer mentoring, or cross-age tutoring. Likewise, pupils with special interests or exceptional talent in mathematics may need enrichment lessons or additional resources to challenge and engage them. The talent and interest of these pupils must be nurtured and supported so that they have the opportunity and guidance to excel. Schools and school systems must take care to accommodate the special needs of some pupils without inhibiting the learning of others.

Achieving the National Curriculum objectives requires a significant allocation of human and material resources in schools and classrooms. Instructional tools, curriculum materials, special supplemental programs, and the skilful use of community resources undoubtedly play important roles. An even more important component is the professional development of teachers. Teachers need help to understand the strengths and needs of pupils who come from diverse backgrounds, who have specific disabilities, or who possess a special talent and interest in mathematics. To accommodate differences among pupils effectively and sensitively, teachers also need to understand and confront their own beliefs and biases.

Pupils learn mathematics through the experiences that teachers provide. Thus, pupils' understanding of mathematics, their ability to use it to solve problems, and their confidence in, and disposition toward, mathematics are all shaped by the teaching they encounter in school. The improvement of mathematics education for all pupils requires effective mathematics teaching in all classrooms.

Teaching mathematics well is a complex endeavour, and there are no easy recipes for helping all pupils learn or for helping all teachers become effective. Nevertheless, much is known about effective mathematics teaching, and this knowledge should guide professional judgement and activity. To be effective, teachers must know and understand deeply the mathematics they are teaching and be able to draw on that knowledge with flexibility in their teaching tasks. They need to understand and be committed to their pupils as learners of mathematics and as human beings and be skilful in choosing from and using a variety of pedagogical and assessment strategies. In addition, effective teaching requires reflection and continual efforts to seek improvement. Teachers must have frequent and ample opportunities and resources to enhance and refresh their knowledge.

Teachers need several different kinds of mathematical knowledge about the whole domain; deep, flexible knowledge about curriculum goals and about the important ideas that are central to their class level; knowledge about the challenges pupils are likely to encounter in learning these ideas; knowledge about how the ideas can be represented to teach them effectively; and knowledge about how pupils' understanding can be assessed. This knowledge helps teachers make curricular judgements, respond to pupils' questions, and look ahead to where concepts are leading and plan accordingly. Pedagogical knowledge, much of which is acquired and shaped through the practice of teaching, helps teachers understand how pupils learn mathematics, become facile with a range of different teaching techniques and instructional materials, and organise and manage the classroom. Teachers need to understand the key ideas of mathematics and be able to represent mathematics as a coherent and connected enterprise.

Effective mathematics teaching requires a serious commitment to the development of pupils' understanding of mathematics. Because pupils learn by connecting new ideas to prior knowledge, teachers must understand what their pupils already know. Effective teachers know how to ask questions and plan lessons that reveal pupils' prior knowledge; they can then design experiences and lessons that respond to, and build on, this knowledge.

Teachers have different styles and strategies for helping pupils learn particular mathematical ideas, and there is no one "right way" to teach. However, effective teachers recognise that the decisions they make shape pupils' mathematical dispositions and can create rich settings for learning.

One of the complexities of mathematics teaching is that it must balance purposeful, planned classroom lessons with the ongoing decision making that inevitably occurs as teachers and pupils encounter unanticipated discoveries or difficulties that lead them into uncharted territory. Teaching mathematics well involves creating, enriching, maintaining, and adapting teaching to move toward mathematical goals, capture and sustain interest, and engage pupils in building mathematical understanding.

Teachers make many choices each day about how the learning environment will be structured and what mathematics will be emphasised. These decisions determine, to a large extent, what pupils learn. Effective teaching conveys a belief that each pupil can and is expected to understand mathematics and that each will be supported in his or her efforts to accomplish this goal.

Teachers establish and nurture an environment conducive to learning mathematics through the decisions they make, the conversations they orchestrate, and the physical setting they create. Teachers' actions are what encourage pupils to think, question, solve problems, and discuss their ideas, strategies, and solutions. The teacher is responsible for creating an intellectual environment where serious mathematical thinking is the norm. More than just a physical setting with desks, bulletin boards, and posters, the classroom environment communicates subtle messages about what is valued in learning and doing mathematics.

In effective teaching, worthwhile mathematical tasks are used to introduce important mathematical ideas and to engage and challenge pupils intellectually. Well-chosen tasks can pique pupils' curiosity and draw them into mathematics. The tasks may be connected to the real-world experiences of pupils or they may arise in contexts that are purely mathematical. Regardless of the context, worthwhile tasks should be intriguing, with a level of challenge that invites speculation and hard work. Worthwhile tasks alone are not sufficient for effective teaching. Teachers must also decide what aspects of a task to highlight, how to organise and orchestrate the work of the pupils, what questions to ask to challenge those with varied levels of expertise, and how to support pupils without taking over the process of thinking for them and thus eliminating the challenge.

Effective teaching involves observing pupils, listening carefully to their ideas and explanations, having mathematical goals, and using the information to make teaching decisions. Teachers who employ such practices motivate pupils to engage in mathematical thinking and reasoning and provide learning opportunities that challenge pupils at all levels of understanding. Effective teaching requires continuing efforts to learn and improve. These efforts include learning about mathematics and pedagogy, benefiting from interactions with pupils and colleagues, and engaging in ongoing professional development and self-reflection.

When assessment is an integral part of mathematics instruction, it contributes significantly to all pupils' mathematics learning. When assessment is discussed in connection with standards, the focus is sometimes on using tests to certify pupils' achievement, but there are other important purposes of assessment. Assessment should be more than merely a test at the end of teaching to see how pupils perform under special conditions; rather, it should be an integral part of teaching that informs and guides teachers as they make teaching decisions. Assessment should not merely be done to pupils; rather, it should also be done for pupils, to guide and enhance their learning.

Good assessment can enhance pupils' learning in several ways. First, the tasks used in an assessment can convey a message to pupils about what kinds of mathematical knowledge and performance are valued. That message can in turn influence the decisions pupils make, for example, whether or where to apply effort in studying. Thus, it is important that assessment tasks be worthy of pupils' time and attention. Activities that are consistent with (and sometimes the same as) the activities used in teaching should be included. When teachers use assessment techniques such as observations, conversations and interviews with pupils, they are likely to learn through the process of articulating their ideas and answering the teacher's questions.

Feedback from assessment tasks can also help pupils in setting goals, assuming responsibility for their own learning, and becoming more independent learners. To ensure deep, high-quality learning for all pupils, assessment and teaching must be integrated so that assessment becomes a routine part of the ongoing classroom activity rather than an interruption. Such assessment also provides the information teachers need to make appropriate teaching decisions.

Assessment should reflect the mathematics that all pupils need to know and be able to do, and it should focus on pupils' understanding as well as their procedural skills. Teachers need to have a clear sense of what is to be taught and learned, and assessment should be aligned with their teaching goals. By providing information about pupils' individual and collective progress toward the goals, assessment can help ensure that everyone moves productively in the right direction.

If teachers are committed to pursuing goals and practices consistent with those in the National Curriculum, satisfying the requirements of the national assessment system is challenging. It is not realistic for teachers simply to ignore the pressure of these tests. Pupils may be penalised if they do not perform well, staff or school evaluations may depend on demonstrating progress, and decisions about resource allocation and salaries may be tied to test scores. Yet "teaching to the test", a political reality when the consequences of test scores are significant, can undermine the integrity of teaching. To put teachers in the position of deciding between what they believe best enhances their pupils' learning and what is required to survive in the educational system puts them in a difficult position. Assessments must be closely linked to the goals teachers are being asked to achieve.

Mathematics teachers must develop and maintain the mathematical and pedagogical knowledge they need to teach their pupils well. One way to do this is to collaborate with their colleagues and to create their own learning opportunities. They should also seek out high-quality professional development opportunities that fit their learning needs.

Mathematics teachers generally are responsible for what happens in their own classrooms and can try to ensure that their classrooms support learning for all pupils. The decisions teachers make in the classroom about how to offer all pupils experiences with important mathematics and how to accommodate the wide-ranging interests, talents, and experiences of pupils are essential to giving all pupils access to mathematics. Although many matters bearing on their classrooms are beyond teachers' sole control, they need to take the initiative in discussing trends and opportunities in mathematics education within their schools.

Teachers must help pupils be confident, engaged mathematics learners. Mathematics teachers ultimately control the range of mathematical ideas made available to their pupils. They have the responsibility to ensure that a full range of mathematical content and processes are taught and that mathematical emphases fit together into a coherent whole. They can do so by using the available textbooks, support materials, technology, and other instructional resources effectively and tailoring these resources to their particular situations so that their goals for mathematics teaching and their pupils' needs are met. Teachers need to seek out support and professional development as they implement current or new curricula. They should constantly evaluate curricular materials and offer suggestions to teacher-leaders, and they should find ways to be involved in choosing the instructional material for their school. The results of this survey clearly indicate the introduction and implementation of the National Curriculum has had a favourable impact upon specific, dynamic elements which contribute to staff attitudes towards morale within the teaching profession.

10.3.4 Section D: Teachers' Support Mechanisms

Research Question: *Has the National Curriculum created a climate in which staff may call upon colleagues expertise and experience in the form of support mechanisms for delivering the curriculum?*

General Conclusions

The introduction of the National Curriculum has had an effect upon teachers' support mechanisms within school (see Table 6.20)

Responses received overwhelmingly indicate a perceived improvement on every item within this section of the questionnaire. Table 10.8 summarises the results as they apply to teachers' support mechanisms, and are based on figures quoted in Appendix 19, where a mean score of greater than 4 indicates an improvement in the situation.

Table 10.8 Perceived improvement in teachers' support mechanisms

Item (8 of 8 items)
q.31. Initial level of newly qualified teachers
q.32. Quality of provision of in-service training for teachers
q.33. Head-teachers' guidance on teachers
q.34. The advice offered by other colleagues
q.35. Teachers' knowledge related to quantity of subjects
q.36. Teachers' knowledge related to quantity of subjects
q.37. Teachers' classroom performance
q.38. Subject co-ordinators support for teachers

<u>Role Related Conclusions</u>

Common perceptions and consensus were found on the issue of:

- Subject co-ordinators support of teachers (improving trend)

<u>Person Related Conclusions</u>

Differences between males and females occurred on all eight items in this section.

In the groupings relating to teaching experience common perceptions and consensus were found on the issue of:

- Quality and provision of in-service training for teachers (improving trend)
- The advice offered by colleagues (improving trend)

For sustained improvement in pupil achievement to occur in every Welsh school, it is important that teachers have a deep understanding of mathematics content and possess the conceptual understanding and problem solving abilities related to the topics that they teach, along with skills in using a wide variety of teaching methods. Therefore schools must develop and implement comprehensive professional development to accomplish these goals.

Teachers need to examine the mathematics they are teaching, consider how their teaching impacts upon pupil achievement and determine how they can improve what they are currently doing. They actually need to consider what a teaching program based upon high standards actually looks like in a classroom and what they need to do to ensure that all pupils succeed in meeting the high standards.

It must be noted that professional development in mathematics needs to be ongoing. The most effective professional development occurs in the context of long-term, ongoing programs that are school-based and subject matter specific, provide follow-up and involve collaboration among teachers in planning, implementation and improvement of classroom performance. Sustained participation in professional development is necessary to ensure that teachers develop and maintain a deep understanding of mathematics and develop, implement and evaluate plans to improve their classroom teaching programs.

As new mathematics teachers are appointed, there is need to consider the extent and rigor of the teachers preparation in mathematics and the teaching of mathematics. This will range from personal background in mathematics and of course level of training and preparation for the teaching of mathematics. Additionally, when appointing mathematics teachers, one needs to consider the breadth and depth of mathematical knowledge and experience possessed by those seeking to enter the mathematics teaching profession.

Pre-service education in mathematics cannot in itself prepare a new teacher. All teachers, including those who are thoroughly prepared, need support if they are to present a challenging, balanced mathematics curriculum. The well planned use if INSET budgets, are one way of supporting staff providing time for teachers to participate in specially designed staff development activities and to work with other colleagues in the design and delivery of rigorous mathematics programs within their classrooms.

Teachers need to know and use mathematical knowledge and pedagogical knowledge. They must be information providers, planners, consultants, and explorers of uncharted mathematical territory. They must adjust their practices and extend their knowledge to reflect changing curricula and technologies and to incorporate new knowledge about how pupils learn mathematics. They also must be able to describe and explain why they are aiming for particular goals.

Pre-service preparation is the foundation for mathematics teaching, but it gives teachers only a small part of what they will need to know and understand throughout their careers. No matter how well prepared teachers are when they enter the profession, they need sustained, ongoing professional development in order to offer pupils a high-quality mathematics education. They must continue to learn new or additional mathematics content, study how pupils learn mathematics, analyse issues in teaching mathematics, and use new materials and technology. Teachers must develop their own professional knowledge using research, the knowledge base of the profession, and their own experiences as resources. Pre-service education, therefore, needs to prepare teachers to learn from their own teaching, from their pupils, from curriculum materials, from colleagues, and from other experts. The reality is simple: unless teachers are able to take part in ongoing, sustained professional development, they will be handicapped in providing high-quality mathematics education. The findings of this research clearly show practitioners within schools perceive the implementation of the National Curriculum has created a positive climate of support for delivering the curriculum.

10.3.5 Section E: Objectives/ Outcomes

Research Question: *Has the National Curriculum provided clarity in terms of the objectives and outcomes schools are able to set for their mathematics teaching?*

General Conclusions

The National Curriculum had an effect upon objectives/outcomes within school (see table 6.21).

Responses suggest an overall view that the situation had improved significantly on all six items in this section. Table 10.9 summarises the perceived improvement in objectives/outcomes, as indicated in Appendix 19, where a mean score greater than 4 indicates an improvement in the situation.

Table 10.9 Perceived improvement objectives/outcomes

Item (6 of 6 items)
q. 39. Clarity of your schools objectives in mathematics
q.40. Clarity of your school's outcomes in mathematics
q.41. Clarity of objectives in mathematics
q.42. Clarity of your curriculum outcomes in mathematics
q.43. The clarity of your objectives in teaching
q.44. The presence of objectives in all aims

Role Related Conclusions

Common perceptions and consensus were found on the issues of:

- The clarity of your schools objectives in mathematics (improving trend)
- The clarity of your school's outcomes in mathematics (improving trend)
- The clarity of your curriculum outcomes in mathematics (improving trend)
- The clarity of your objectives in teaching (improving trend)

Person Related Conclusions

Differences between males and females occurred on all six items in this section.

In the groupings based upon teaching experience common perceptions and consensus were found on the issue of:

- The clarity of objectives in mathematics (improving trend)
- The clarity of objectives in teaching (improving trend)
- The presence of objectives in all aims (improving trends)

Qualification Related Conclusion

Common perceptions and consensus were found on the issue of:

- The clarity of schools objectives in mathematics (improving trend)

The use of aims, objectives and the consideration of outcomes can be used for three major purposes, that is, to ensure quality, to indicate goals, and to promote change. One way in which the National Curriculum framework has contributed within each of these areas is by shaping conversations about mathematics education. The whole innovative framework offers common language, examples, and recommendations to engage many groups of people in productive dialogue. Although there will never be complete consensus within the mathematics education profession or among the general public about the ideas advanced in any National Curriculum, the programmes of study provide a guide for focused, sustained efforts to improve pupils school mathematics achievement.

The National Curriculum supplied guidance and vision while leaving specific curriculum decisions in terms of detailed planning, to the local level. Therefore for the first time in Wales the National Curriculum set forth a comprehensive and coherent set of goals for mathematics for all pupils within primary education which continues to focus attention on the curriculum, teaching methods, and assessment efforts for the immediate future. It serves as a resource for teachers, education leaders, and policymakers to use in examining and improving the quality of mathematics teaching programs, guide the development of curriculum frameworks, assessment, and teaching materials.

The objectives of mathematics are statements reflecting basic precepts that are fundamental to a high-quality mathematics education. These objectives, when considered in terms of outcomes should be useful as perspectives on which teachers can base decisions that affect school mathematics, clearly a focused curriculum is an important aspect of what is needed to improve school mathematics and standards. Additionally, pupils must have opportunities to learn mathematics under the guidance of competent and committed teachers with thorough and precise planning being a major element towards achieving these goals. The research undertaken here has shown clearly that staff within schools throughout Wales have very positive, favourable perceptions about key organisational and planning issues which schools are able to determine for their mathematics teaching.

10.3.6 Section F: Curriculum Content

Research Question: *In relation to the content of the mathematics syllabus, does the National Curriculum provide a viable curriculum?*

General Conclusions

The National Curriculum has had a significant effect on the curriculum content within schools (see Table 6.23).

The survey revealed that the one element upon which the National Curriculum had no effect, was the amount of time allotted to the teaching of mathematics within schools. Table 10.10 summarises the perceived improvement in Curriculum Content, as indicated in Appendix 19.

Table 10.10 : Perceived improvement in curriculum content

Item (7 of 7 items)
Q.45. The quantity of mathematics taught by you
q.46. The standard of mathematics throughout Key Stage 2
q.47. Time which is allotted to teaching mathematics
q.48. The quality of new textbooks published on mathematics
q.49. The variety of textbooks used by you in teaching of mathematics
q. 50. The content of mathematics textbooks used in your classroom
q. 51. The general presentation of mathematics textbooks used by you

Role Related Conclusions

Common perceptions and consensus were found on the issues of:

- The quantity of mathematics taught by you (improving trend)
- The standard of mathematics throughout key stage 2 (improving trend)
- Time which is allotted to teaching mathematics (improving trend)

Person Related Conclusions

However, differences between males and females occurred on all seven items in this section.

In the groupings relating to teaching experience common perceptions and consensus were found on the issue of:

- The variety of textbooks used in the teaching of mathematics (improving trend)

A high quality mathematics program is essential for all pupils within Key Stage 2 and will ultimately provide every pupil with the opportunity to choose among a full range of career paths. An important method to enhance mathematical achievement is for pupils to successfully participate in and complete a rigorous mathematics program of study with clearly defined standards and high expectations. Pupils require sufficient time and opportunities to learn mathematics, as well of course as having teachers who are mathematically proficient, who continuously maintain high expectations, who employ appropriate teaching strategies to help pupils achieve them. There is clearly a need to continue with mathematics programs of study which reflect a balance of basic skills, conceptual understanding and problem solving throughout the Key Stage with a variety of teaching strategies applied.

This solid foundation of mathematics is essential for each pupils future, based upon the premise that all children are capable of learning a rigorous program of mathematics well. Proficiency in mathematics is not an innate characteristic, it is a consequence of persistence, effort, practice, support and encouragement.

Additionally, when developing and planning the curriculum, schools must implement programs of mathematics which allow all students to succeed in mathematics. In implementing such programs within the curriculum, schools must recognise that not all pupils learn mathematics in the same way and that various instructional methods are required. The results of the survey undertaken here show very positive perceptions of teaching staff throughout Wales upon the impact of the National Curriculum upon curriculum content within Wales.

10.3.7 Section G: Curriculum Methodology

Research Question: Has the National Curriculum provided a catalyst for the development and refinement of curriculum methodology?

General Conclusions

The introduction of the National Curriculum has had an effect upon curriculum methodology within schools (see Table 6.25).

Every item had a favourable response, indicating a perceived improvement in the situation on the eight items in this section. Table 10.11 summarises the perceived improvement in Curriculum Methodology, as indicated in Appendix 19.

Table 10.11 : Perceived improvement in curriculum methodology

Item (8 of 8 items)
q.52. Your use of teaching aids
q.53. Matching of mathematics taught with children's ability level
q.54. Atmosphere in classrooms to enable learning
q.55. Appropriateness of classroom organisation
q.56. Information given to teachers about innovations
q.57. The introduction of new methods within your classroom
q.58. Teachers attitude towards the introduction of new methods
q.59. Methodological recommendations offered in mathematical texts

Role Related Conclusions

Common perceptions and consensus were found on the issues of:

- Your use of teaching aids (improving trend)
- Matching of the mathematics taught with children's ability level (improving trend)
- Atmosphere in classrooms to enable learning (improving trend)
- Appropriateness of classroom organisation (improving trend)
- The introduction of new methods within your classroom (improving trend)
- Methodological recommendations offered in mathematical texts (improving trend)

Person Related Conclusions

Differences between males and females occurred on all eight items in this section.

In relation to groupings based upon teaching experience common perceptions and consensus were found on the issue of:

- Matching mathematics taught with children's abilities (improving trend)

A school mathematics curriculum is a strong determinant of what pupils have an opportunity to learn and what they do learn. In a coherent curriculum, mathematical ideas are linked to and build on one another so that pupils' understanding and knowledge deepens and their ability to apply mathematics expands. An effective mathematics curriculum focuses on important mathematics, which will prepare pupils for continued study and for solving problems in a variety of school, home, and work settings. A well-articulated curriculum challenges pupils to learn increasingly more sophisticated mathematical ideas as they continue their studies.

Mathematics comprises different topic strands, such as algebra and geometry, but the strands are highly interconnected. The interconnections should be displayed prominently in the curriculum and in teaching materials and lessons. A coherent curriculum effectively organises and integrates important mathematical ideas so that pupils can see how the ideas build on, or connect with other ideas, thus enabling them to develop new understandings and skills.

Curricular coherence is also important at the classroom level. In planning individual lessons, teachers should strive to organise the mathematics so that fundamental ideas form an integrated whole. Big ideas encountered in a variety of contexts should be established carefully, with important elements such as terminology, definitions, notation, concepts, and skills emerging in the process. Sequencing lessons coherently across units and school years is challenging and teachers also need to be able to adjust and take advantage of opportunities to move lessons in unanticipated directions.

School mathematics curricula should focus on mathematics content and processes that are worth the time and attention of pupils. Mathematics topics can be considered important for different reasons, such as their utility in developing other mathematical ideas, in linking different areas of mathematics, or in deepening pupils' appreciation of mathematics as a discipline and as a human creation. Ideas may also merit curricular focus because they are useful in representing and solving problems within or outside mathematics.

Mathematical thinking and reasoning skills, including making conjectures and developing sound deductive arguments, are important because they serve as a basis for developing new insights and promoting further study. Many concepts and processes, such as symmetry and generalisation, can help pupils gain insights into the nature and beauty of mathematics. In addition, the curriculum should offer experiences that allow pupils to see that mathematics has powerful uses in modelling and predicting real-world phenomena.

Although any curriculum document is fixed at a point in time, the curriculum itself need not be fixed. Different configurations of important mathematical ideas are possible and to some extent inevitable. The relative importance of particular mathematics topics is likely to change over time in response to changing perceptions of their utility and to new demands and possibilities.

Learning mathematics involves accumulating ideas and building successively deeper and more refined understanding. A school mathematics curriculum should provide a road map that helps teachers guide pupils to increasing levels of sophistication and depths of knowledge. Such guidance requires a well-articulated curriculum so that teachers at each level understand the mathematics that has been studied by pupils at the previous level and what is to be the focus at successive levels. Without a clear articulation of the curriculum across all levels and years, duplication of effort and unnecessary review are inevitable. A well-articulated curriculum gives teachers guidance regarding important ideas or major themes, which receive special attention at different points in time. It also gives guidance about the depth of study warranted at particular times and when closure is expected for particular skills or concepts.

Electronic calculators and computers, are essential tools for teaching, learning, and doing mathematics. They furnish visual images of mathematical ideas, they facilitate organising and analysing data, and they compute efficiently and accurately. They can support investigation by pupils in every area of mathematics, including geometry, statistics, algebra, measurement, and number. When technological tools are available, pupils can focus on decision making, reflection, reasoning, and problem solving.

Technology offers teachers options for adapting teaching to special needs. Pupils who are easily distracted may focus more intently on computer tasks, and those who have organisational difficulties may benefit from the constraints imposed by a computer environment. Pupils who have trouble with basic procedures can develop and demonstrate other mathematical understandings, which in turn can eventually help them learn the procedures. The possibilities for engaging pupils with physical challenges in mathematics are dramatically increased with special technologies.

The effective use of technology in the mathematics classroom depends on the teacher. Technology is not a panacea. As with any teaching tool, it can be used well or poorly. Teachers should use technology to enhance their pupils' learning opportunities by selecting or creating mathematical tasks that take advantage of what technology can do efficiently and well.

Technology not only influences how mathematics is taught and learned but also affects what is taught and when a topic appears in the curriculum. Technology can help teachers connect the development of skills and procedures to the more general development of mathematical understanding. As some skills that were once considered essential are rendered less necessary by technological tools, pupils can be asked to work at higher levels of generalisation or abstraction.

To make technology an essential part of classrooms, the technological tools must be selected and used in ways that are compatible with the teaching goals. Decisions to incorporate new technology also require that teachers be prepared and supported in using it to serve teaching goals. Teachers must themselves experience how technology can enhance the learning of mathematics and explore models for incorporating it in their classroom practice. Moreover, technology must be embedded in the mathematics curriculum rather than be treated as just another flashy add-on. Without coherent, comprehensive implementation plans, the incorporation of new technology is likely to fall short in improving mathematics teaching and learning. The findings of this research show teaching staff throughout schools in Wales perceive very favourably the impact of the National Curriculum upon curriculum methodologies within schools.

10.3.8 Section H: School – Community

Research Question: *Has the National Curriculum provided benefits in terms of improved relationships between the school and the wider external community?*

General Conclusions

Results indicated the introduction of the National Curriculum had an effect upon school/community relations (see Table 6.27).

Responses to relations between teachers and parents indicated the introduction of the National Curriculum had no effect on the situation. Generally, the overall responses indicated the perception of no change/improvement in the situation. Significantly, 57.7% perceive parent's respect for teachers has worsened. Table 10.12 summarises the perceived improvement in School–Community Relationships, as indicated in Appendix 19.

Table 10.12 : Perceived improvement in school/community relationships

Item (2 of 5 items)
q. 60. Relations between teachers and parents
q.62. The co-operation of the community with the school

Role Related Conclusions

Common perceptions and consensus were found on the issues of:

- Relations between teachers and parents (improving trend)
- Parents' respect for teachers (worsening trend)

Person Related Conclusions

Differences between males and females occurred on all five items in this section.

In the groupings based upon teaching experience common perceptions and consensus were found on the issue of:

- Communities respect for school (worsening trend)
- The influence of school within the community (worsening trend)

Parental involvement is a critical factor in increasing pupil achievement. Far too long, were parents feeling disenfranchised from the school system. Efforts were and are continuing to be made to empower parents as productive and effective partners in education. At the same time, parents must recognise their responsibility to support learning in school and to provide strong support for their children's learning at home. Teachers, governors parents/community members need to be continually involved in and informed of the development and implementation of challenging, rigorous balanced mathematics programs of study. Like teachers, the parents and the community have a stake in the success of school programs. Parents should be an integral part at every level of decision making which affects the pupils. It is important that parents are involved in setting the rigor of standards and looking at the academic needs of all pupils in their school. They also should be informed of the mathematical expectations of the levels of their own children.

Teachers and schools should invite families and community members to participate in examining and improving mathematics education. All partners in this enterprise need to understand the changing goals and priorities of school mathematics, as expressed within the National Curriculum framework. Families need to know what options are available for their children and why an extensive and rigorous mathematics education is important. When parents understand and support the schools' mathematics program, they can be invaluable in convincing their children of the need to learn mathematics and to take schooling seriously. Families become advocates for education standards when they understand the importance of a high-quality mathematics education for their children.

Families can establish learning environments at home that enhance the work initiated at school. Respect shown to and for teachers is often carried over from parent to child. By providing a quiet place for a child to read and attend to homework and by monitoring pupils' work, families can signal that they believe mathematics is important. If families and other members of the public do not understand the intent of, and rationale for, improvements in mathematics education, they can halt even the most carefully planned initiatives. The National Curriculum was written with the hope that the conversations it engenders will ultimately generate a widespread commitment to improving mathematics education. As part of this effort, it is the responsibility of the education community to inform the general public and its elected representatives about the goals and priorities in mathematics education, thereby empowering them to participate knowledgeably in its improvement. The results of this research suggest that there is need for improvement on the issue of relationships between schools and the wider external community, particularly so on issues of parental respect towards teachers, community respect for schools and the influence of schools within the wider community.

10.3.9 Section I: Mathematical Textbooks

<u>Research Question:</u> *Has the National Curriculum initiated development and improvements in relation to mathematical textbooks available for delivering the subject?*

<u>**General Conclusions**</u>

The introduction of the National Curriculum has been perceived as having considerable effect upon mathematical textbooks produced (see Table 6.29).

The null hypothesis was accepted on the issue of mathematical textbooks not following the logical sequence of the subject, indicating respondents feel the introduction of the National Curriculum has had no effect on this item. Clearly, the overall perception was one of improvement, in relation to mathematical textbooks available for delivering the subject within schools. Table 10.13 summarises the perceived improvement in Mathematical Textbooks, as indicated in Appendix 19.

Table 10.13 : Perceived improvement in mathematical textbooks

Item (10 of 12 items)
q.65.The quality of graphs, pictures tables and diagrams you use
q.66. The number of tasks provided for children to solve
q.68. Provides a content that meets the children's needs
q.69. Restricts my teaching methods
q.71. Do not follow the logical sequence of the subject
q.72. Are adequate for children's self study
q.73. Present examples, activities and exercises relevant to the children's experience
q.74. Greatly assist me in lesson preparation
q.75. Do not include material in the form of motivation or enrichment topics
q. 76. Are accompanied by Teachers' Manuals I use regularly

Role Related Conclusions

Common perceptions and consensus were found on the issues of:

- The quality of graphs, pictures, tables and diagrams you use (improving trend)
- The number of tasks provided for children to solve (improving trend)
- Are too abstract for the children's age they are produced for (improving trend)
- Provides a content that meets the children's needs (improving trend)
- Restricts my teaching methods (improving trend)
- Do not follow the logical sequence of the subject (worsening trend)
- Are adequate for children's self-study (worsening trend)
- Present examples, activities and exercises relevant to the children's experience (improving trend)
- Greatly assist me in lesson preparation (improving trend)
- Do not include material in the form of motivation or enrichment topics (improving trend)
- Are accompanied by Teachers' Manuals I use regularly (improving trend)

Person Related Conclusions

Differences between males and females occurred on all twelve items in this section.

In the groupings based upon teaching experience common perceptions and consensus were found on the issue of:

- Textbooks greatly assisting lesson preparation (improving trend)
- Manuals being used regularly (improving trend)

Qualification Related Conclusion

Common perceptions and consensus were found on the issue of:

- The number of tasks provided for children to solve (improving trend)

Choices of mathematics teaching materials can be controversial. Teachers should be prepared to work with new curricular materials, and they need considerable time to "live with" curricula in order to discover their strengths and weaknesses. Only then can they develop the kinds of knowledge necessary to make materials work well in particular contexts. The selection of curriculum and materials, therefore, needs to be a long-term collaborative process involving teachers and teacher-leaders. If teaching materials are not consistent with the expectations of families and community members or do not seem reasonable to them, serious difficulties can arise. For that reason, teachers should help families understand the goals and content of curricular materials, and community members should be consulted and informed about decisions regarding curricula and materials. The results of this survey indicate that the introduction of the National Curriculum has had a favourable impact upon the development and improvement of mathematical textbooks available for delivering the subject.

10.3.10 Section J: Proportion of Time/ Emphasis

Research Question: *Has the National Curriculum provided clarity in relation to the adoption of specific subject teaching methodologies within schools?*

General Conclusions

The introduction of the National Curriculum has had an effect upon the proportion/emphasis of teaching time used within schools (see Table 6.31).

Every aspect within the methodology section is perceived as having improved significantly in relation to the time and emphasis placed upon the range of methods chosen to teach mathematics within schools. Table 10.14 summarises the perceived improvement in proportion of time/emphasis, as indicated in Appendix 19.

Table 10.14 Perceived improvement in use of teaching time

Item (10 of 10 items)
q.77. Lecture Method
q.78. Demonstration/ illustration
q. 79. Discussion
q.80. Drill and Practice
q.81. Problem Solving
q.82. Discovery Approaches
q.83. The expository Style
q.84. Investigational work
q.85. Practical activity
q.86. Programmed learning

Role Related Conclusions

Common perceptions and consensus were found on the issues of:

- Lecture Method (improving trend)
- The expository style (improving trend)
- Investigative Work (improving trend)
- Practical Activity (improving trend)
- Programmed learning (improving trend)

Person Related Conclusions

Differences between males and females occurred on all ten items in this section.

In groupings based upon teaching experience common perceptions and consensus were found on the issue of:

- Problem solving (improving trend)
- Discovery approaches (improving trend)
- Practical activity (improving trend)

Both the pupil and the teacher must share responsibility for the pupil's learning of mathematics. Learning requires persistence, effort and practice by the pupil. Using appropriate instructional materials teachers determine what mathematics to teach and how to teach it, with the setting of appropriate tasks for the pupils to undertake. The teacher's goal is to have each pupil consistently challenged at a level which is appropriate for that pupil.

Adequate teaching methods and appropriate resources are critical to support mathematically rich learning and teaching. Teaching methods selected by teachers should support a balanced mathematics program, schools should review materials and methods selected to continuously determine which best supports a balanced teaching program which meets the needs of the pupils.

As a result of lessons and tasks having different mathematical objectives and because pupils learn in different ways teachers need a repertoire of instructional strategies and of course, materials. No single instructional strategy or teaching method is best or indeed appropriate in all situations. As investigated within this study, teachers increasingly choose to use expository or direct instruction, hands-on learning, classroom discussion, discovery, individual work or group work at various times. Essentially, teachers need to determine the balance of teaching strategies appropriate for their pupils and the results desired for different lessons. Regardless of the tasks of the teaching strategy, it is crucial that pupils be intellectually engaged and stimulated with rigorous mathematical content. In every classroom activity the teacher must constantly keep in mind the mathematics involved and focus the lesson on the mathematics. Clearly the results of the survey undertaken here show very positive perceptions of teaching staff throughout Wales upon the impact of the implementation of the National Curriculum in relation to the adoption of specific teaching methodologies within schools.

10.3.11 Section K: General Question

Research Question: *Has the National Curriculum improved the chances of raising standards in primary education?*

General Conclusions

The general perception was the National Curriculum had an effect upon the chances of raising standards in primary schools (see Table 6.33).

The overall responses were broad, with quite a number of highly polarised views. Although small numbers of respondents had scored previous items at 1 or even 2, some 24 respondents were prepared to score this item as 1, and 34 as a 2. This suggests that some primary school staff may have very strong negative feelings about the National Curriculum that they do not link with the positive responses made in other areas of the questionnaire. Nevertheless, 48.1% of respondents perceived the introduction of the National Curriculum as having improved the likelihood of raising standards in primary education. Such a positive response is essential if such a major initiative is to succeed within schools.

Role Related Conclusions

Common perceptions and consensus were found on the issue of:

- The National Curriculum having improved the likelihood of raising standards in primary education (improving trend)

Person Related Conclusions

Differences between males and females occur on this item in this section.

In relation to teaching experience, common perceptions and consensus were found on this issue (improving trend)

There is an emerging consensus at local and national levels of the importance of setting high expectations and standards along with the adoption of clear accountability measures, subsequently there is development of rigorous academic content and related performance standards in each subject. These standards are of course incorporated within the Standard Assessment Tests, administered within the Key Stages.

When such standards have become widely known and accepted within schools, pupils, teachers and parents can work together to achieve the stated goals. Pupils may begin to see how each year's work builds upon the work of previous years and lays a foundation for the next year's work. Additionally, teachers have a constant focus for placing emphasis throughout the year to assure every pupil is prepared for the next year's work. Parents have a clear understanding of what mathematical content looks like at the appropriate level of the key stage so they can help their children at each level of the mathematics program.

Achieving high standards in mathematics education calls for clear goals. It calls for the active participation of teachers, policymakers, curriculum developers, researchers, families, pupils, and community members. The National Curriculum has provided a catalyst for the continued improvement of mathematics education. It represents our current understanding of mathematics teaching and learning and the contextual factors that shape them. It was created with the input and collaboration of members of all the communities mentioned above. It articulates high but achievable standards.

Realising the vision of mathematics education described within the National Curriculum document requires the continued creation of high-quality teaching materials and technology. It requires enhanced preparation for teachers and increased opportunities for professional growth. It requires the creation of assessments aligned with curricular goals. Realising the objectives depends on the participation of all the parties mentioned above in reflecting on, supporting, and improving educational practice. The difficulty of the task should not be underestimated, but it can be done.

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APPENDIX 1

LETTER TO HEADTEACHERS RE RESEARCH USE OF NFER RESULTS

26 Burns Crescent,
Cefn Glas,
Bridgend CF31 4PY.

Tel: 01656 662753

24th March 1993

Mr. W.A. Jones,
Head teacher,
Mynydd Cynffig Junior School,
Kenfig Hill
Bridgend,
Mid Glamorgan CF33 6ET

Dear Mr. Jones,

I am currently undertaking part-time research relating to the mathematical attainment of children within Key Stage 2.

Following the recent discussion we had on the issue, I write seeking permission to involve your school in the form of testing and analysing the results of children's performance on a mathematical test instrument which is currently used within the school. Data collated from the test instrument will be analysed and compared to establish any trends in mathematical performance of children within the school.

Many thanks for your co-operation in this matter.

Yours sincerely,

Nigel Coombes

APPENDIX 2

LETTER FROM HEADTEACHER GRANTING RESEARCH PERMISSION WITHIN SCHOOL

MID GLAMORGAN EDUCATION AUTHORITY

Research Degrees Committee,
University of Glamorgan,
Pontypridd,
Mid Glamorgan.

Mynydd Cynffig Junior School
Pwllygath Street, Kenfig Hill
Mid Glamorgan. CF33 6ET.

31st March, 1993

Telephone No: 0656 740247

Dear Sir/Madam,

This is a letter of support for Mr. Nigel Coombes, a member of staff at Mynydd Cynffig Junior School, who may use the school as a Collaborating Establishment throughout his higher research degree programme, whose proposed topic is "Mathematical Attainment in Eleven Year Olds".

It is agreed that Mr.Coombes may fully use and administer standardised NFER tests and statistically analyse the findings, comparing them where appropriate with national results.

Also, the use of individual mathematical test items are to be used within the school, thus enabling the indication of order of difficulty with test items administered. Where appropriate results obtained will be compared with the findings of the Assessment of Performance Unit.

Yours faithfully,

W A Jones

W.A.Jones,
Headteacher.

APPENDIX 3

NFER TEST PAPER

National Foundation for Educational Research in England and Wales

MATHEMATICS 10

Name ______________________ Boy or Girl ________

School ______________________ Class ________

Today's date ______________________

Date of birth ______________________

AGE (Years and Completed Months)	RAW SCORE	STANDARDIZED SCORE	PERCENTILE RANK

Note to Teachers

Mark the standardized score on the scale below. Then add and subtract the numbers given for that region. Mark the interval with a broad horizontal line. This gives the 90% confidence interval, i.e. you can be 90 per cent certain that the child's true score is in this band. Full details are given in section 6 of the Teacher's Guide.

EXTREMELY LOW SCORE	MODERATELY LOW SCORE	AVERAGE SCORE	MODERATELY HIGH SCORE	EXTREMELY HIGH SCORE

70 75 80 85 90 95 100 105 110 115 120 125 130 135 140

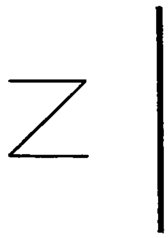
add 8 subtract 4	add 7 subtract 5	add 6 subtract 6	add 5 subtract 7	add 4 subtract 8

NFER-NELSON

1.

$$\begin{array}{r} 5\ 6\ 3 \\ +\ 7\ 9\ 7 \\ \hline \\ \hline \end{array}$$

2. Draw the reflection of this shape.



MIRROR

3. 3.45 pm half-past-midday 7.30 am 1700 hours

Write out these times in the order that they occur in a day.

Answer 1____________________

2____________________

3____________________

4____________________

4. How many less than 127 is 39 ?

Answer ________________

5. A boy delivered newspapers.

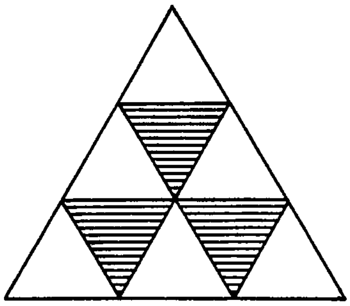
He was paid 80p for every 100 papers he delivered.

How much was he paid for delivering 350 papers?

Answer £ ________________

page total

6.

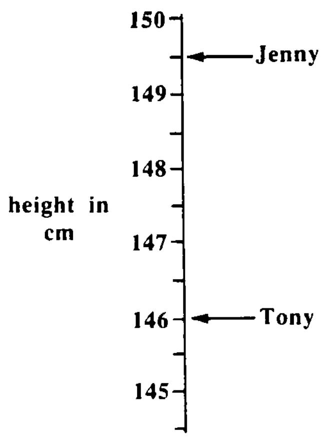


What fraction of the triangle is shaded?

Answer ____________

7. This chart shows the height of Jenny and Tony.

How much taller than Tony is Jenny?



Answer ________________ cm

8.

$$\begin{array}{r} 835 \\ -\ \ 28 \\ \hline \\ \hline \end{array}$$

9. The letter **E** is turned clockwise through a right angle.

Draw it in its new position.

10. Put the correct number in the box.

1 minute = $\square$ seconds

page total

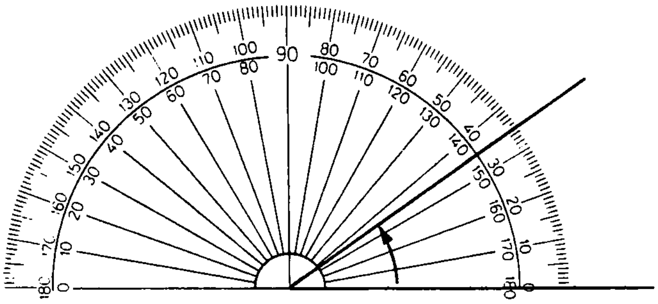
11. A bag had 36 sweets in it.

Wayne took out $\frac{3}{4}$ of them.

How many sweets did he take out?

Answer ________________ sweets

12.



How many degrees does this angle measure?

Answer ________________ degrees

13. Simon has a large carpet in his room.

It is 5 metres long and 4 metres wide.

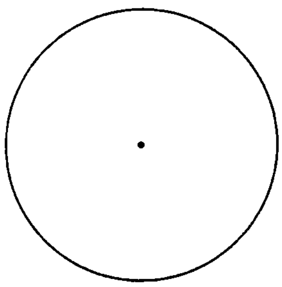
What is the distance all around the edge of the carpet?

Answer ________________ metres

14.

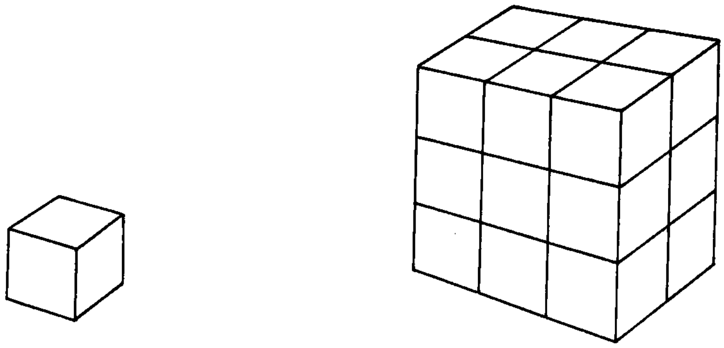
$$\begin{array}{r} 379 \\ \times \quad 7 \\ \hline \\ \hline \end{array}$$

15. Draw a diameter of this circle.



page total

16.



How many small cubes are there in the large block?

Answer ______________ cubes

17. Andrew was 1·43 metres tall.

He grew 2 centimetres.

How tall was he then?

Answer ______________ metres

18.

$4\overline{)5\ 6}$

19. Look at the table of savings.

name	amount saved
Winston	50p
Ann	25p
David	30p
Ian	20p
Aruna	30p
Paul	35p
Sharon	20p

What was the average amount saved?

Answer ______________ p

page total

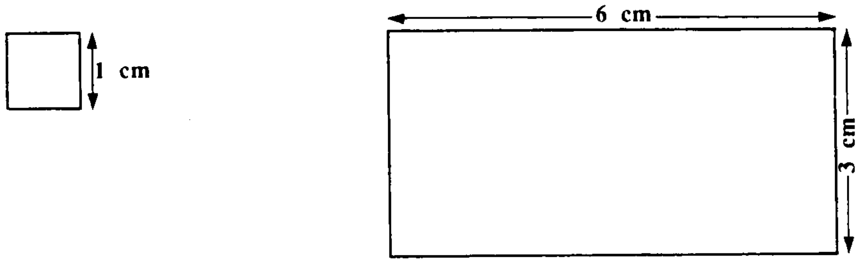
20. How many 10p coins can I get for £1·80 ?

Answer ______________ coins

21. Put a ring round the odd numbers in this list.

30 42 67 35 28

22.



How many 1 cm squares will fit into the rectangle?

Answer ______________ squares

23. Write this number in figures:

five thousand, one hundred and nine

Answer ______________

24. A man paid three sums of money into the Bank over the summer months:

In July he paid in £50·28

In August he paid in £37·50

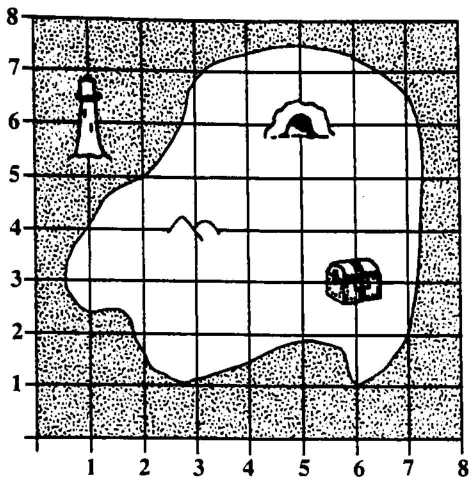
In September he paid in £17·40

How much money did he pay in altogether?

Answer £ ______________

page total

25.



The hills are at (3, 4)

The treasure chest is at (,   )

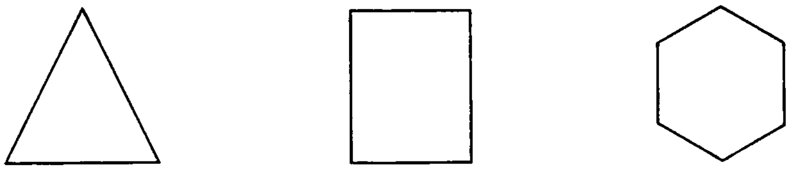
26.

rectangle

triangle

hexagon

Write the correct name under each shape.



__________ __________ __________

27.

$$\begin{array}{r} 219 \\ +\,683 \\ \hline \end{array}$$

______

28.

$$a - 9 = 10$$

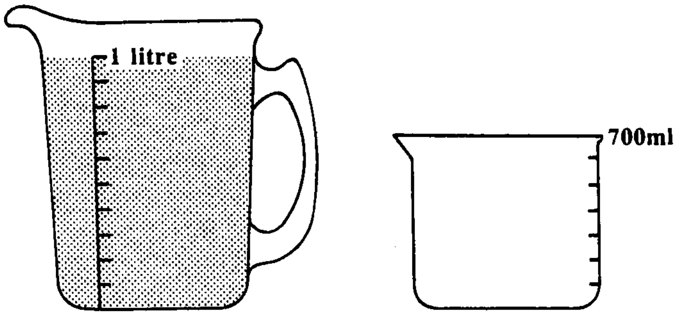
$a =$ __________

29.

$324 \div 6 =$ __________

page total

30.



The jug holds 1 litre of water.

The jar is filled from the jug.

How much water will be left in the jug?

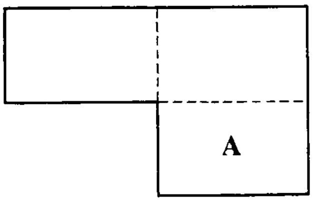
Answer ______________ ml

31.

3·6 × 10 = ______________

32. The area of this whole garden is 18 square metres.

What is the area of the part labelled A?



Answer ______________ square metres

33. Jane had 5 boxes.

Each box weighed 800 grams.

How many **kilograms** was this altogether?

Answer ______________ kilograms

page total

34. A train left at 10.20

It arrived at 11.15

How long did the journey take?

Answer ____________ minutes

35. Take 21 from 47

Answer ____________

36.

$$\begin{array}{r} 7\,8\,6\,0 \\ +\quad 8\,6\,3 \\ \hline \\ \hline \end{array}$$

37.

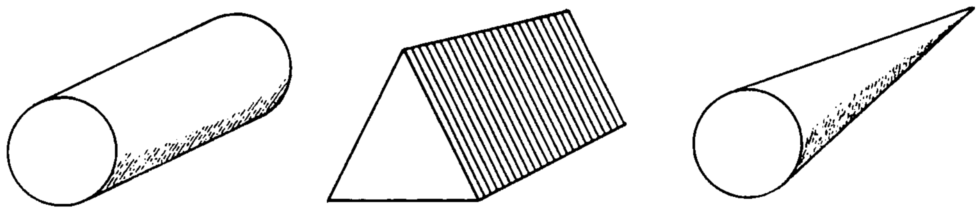
A triangular prism

B cone

C sphere

D cylinder

Put the correct letter under each shape.



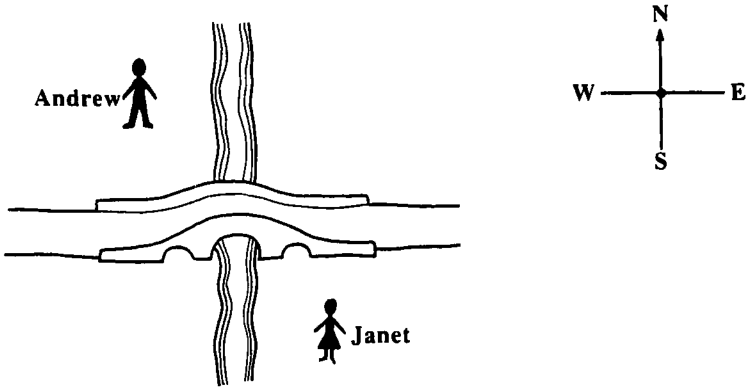
______ ______ ______

38. Multiply 86 by 9

Answer ____________

page total

39.



Andrew is North of the bridge and West of the river.

Janet is ____________ of the bridge and ____________ of the river.

Put the correct word in each space.

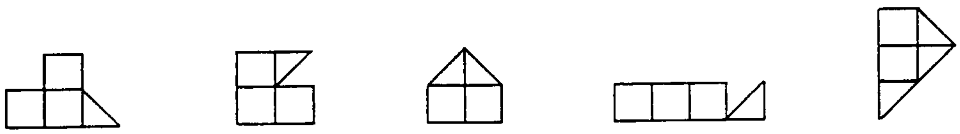
40. Write the missing number in the sequence.

393 384 375 $\square$ 357

41.

$$\begin{array}{r} 3\,2\,3\,4 \\ -\quad 6\,8\,5 \\ \hline \\ \hline \end{array}$$

42.



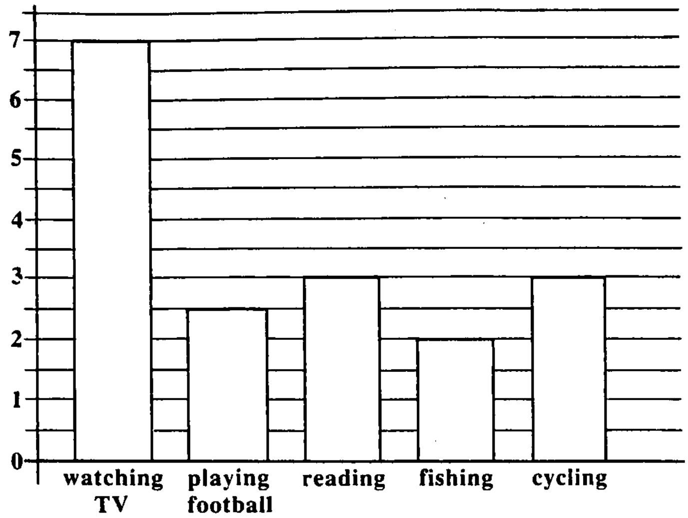
4 of these shapes have the same area.

Put a ring round the odd one out.

43. Put the correct number in the box.

$1\frac{1}{4}$ kg = $\square$ g

page total



The chart shows how Roy spent his spare time last week.

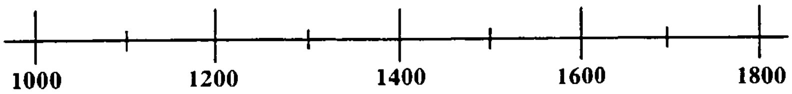
44. How many hours did he watch TV?

Answer ____________ hours

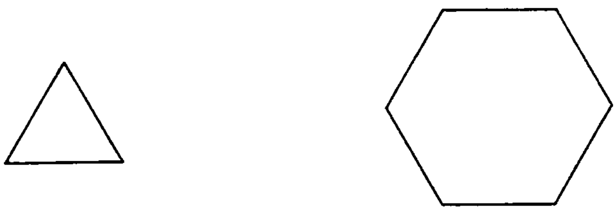
45. How much of his spare time did he spend out of doors? (playing football, fishing and cycling)

Answer ____________ hours

46. Mark with a cross the number 1700



47.

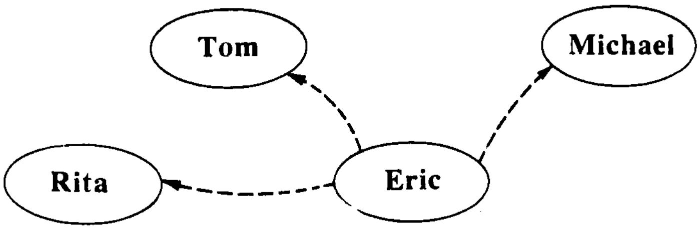


How many of the triangles fit the hexagon?

Answer ____________ triangles

page total

48. In this question the dotted arrows mean "is the father of":



On the diagram draw solid arrows to show "is the son of".

49. Last year a man grew his own vegetables.

This chart shows how much he picked each week.

	week ending July 22	week ending July 29	week ending Aug 5	week ending Aug 12
beetroot	1/4 kg	1/4 kg	1 kg	1/2 kg
broadbeans	1/2 kg	1 3/4 kg	1 1/2 kg	1/2 kg
cabbage	3 1/2 kg	2 3/4 kg	3 kg	2 1/2 kg
peas	1 1/4 kg	1 kg	1 3/4 kg	1/2 kg
potatoes	5 kg	7 1/2 kg	6 1/4 kg	8 1/2 kg
rhubarb	2 3/4 kg	3 1/4 kg	1/2 kg	2 1/2 kg

In which week did he pick 1 kg of peas?

Answer: The week ending ____________

50. In the number 4275 the 2 stands for 200

In the number 7240 the 7 stands for ____________

page total

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NFER-NELSON
INFORMING YOUR DECISIONS

APPENDIX 4

QUESTIONNAIRE

Section A

This questionnaire has been designed to provide a measure of the impact of the National Curriculum. Below are statements which relate to your work. For **every** one of these statements, circle the appropriate number on the evaluation scale.

Point 4 of the scale is deemed neutral i.e. the situation before introduction of the National Curriculum and the Standard Assessment Tests. If you think that changes which happened after introduction worsened the situation, you should move left (points 3, 2, 1), if the changes were of improvement, you have to move to the right (points 5, 6, 7) and if no change happened circle point 4. Point 1 means the worst change and point 7 means the best change.

How did they change according to your opinion?

	Situation Worsened						Improved
A Children's Knowledge							
01. Children's reading skills	1	2	3	4	5	6	7
02. Children's ability to comprehend written passages	1	2	3	4	5	6	7
03. Children's oral skills	1	2	3	4	5	6	7
04. Children's ability to comprehend oral speech	1	2	3	4	5	6	7
05. Children's listening skills	1	2	3	4	5	6	7
06. Children's writing	1	2	3	4	5	6	7
07. Children's ability to perform written commands	1	2	3	4	5	6	7
08. Children's ability in computation	1	2	3	4	5	6	7
09. The ability to problem solve in mathematics	1	2	3	4	5	6	7
10. The quality of knowledge that is acquired by children	1	2	3	4	5	6	7
11. The quantity of knowledge that is acquired by children	1	2	3	4	5	6	7
12. The ability to complete investigative tasks	1	2	3	4	5	6	7
B. Children's Affective Domain							
13. Children's regular attendance	1	2	3	4	5	6	7
14. Children's conduct in school	1	2	3	4	5	6	7
15. Children's respect towards teachers	1	2	3	4	5	6	7
16. Cooperation among children	1	2	3	4	5	6	7
17. Willingness to co-operate with teacher	1	2	3	4	5	6	7
18. Children's sense of responsibility	1	2	3	4	5	6	7
19. Children's interest for learning	1	2	3	4	5	6	7
20. Children's level of commitment	1	2	3	4	5	6	7
21. Children's willingness to volunteer ideas	1	2	3	4	5	6	7
C Teachers' Attitudes							
22. Teachers' degree of preparation	1	2	3	4	5	6	7
23. Teachers' attention to weak students	1	2	3	4	5	6	7
24. Teachers' attitude towards classroom work	1	2	3	4	5	6	7
25. Teachers' attitude towards homework	1	2	3	4	5	6	7
26. Teachers' attitude towards innovations	1	2	3	4	5	6	7
27. Teachers' attitude towards varying teaching styles	1	2	3	4	5	6	7
28. Teachers' attitude towards the importance of pupil assessment	1	2	3	4	5	6	7
29. Teachers' sense of duty	1	2	3	4	5	6	7
30. Teachers' interest in pursuing further studies	1	2	3	4	5	6	7
D Teachers' Support Mechanisms							
31. Initial level of newly qualified teachers	1	2	3	4	5	6	7
32. Quality of provision of In-service training for teachers	1	2	3	4	5	6	7
33. Head-teachers' guidance to teachers	1	2	3	4	5	6	7
34. The advice offered by other colleagues	1	2	3	4	5	6	7
35. Teachers' knowledge related to quantity of subjects	1	2	3	4	5	6	7
36. Teachers' knowledge related to quality of teaching required	1	2	3	4	5	6	7
37. Teachers' classroom performance	1	2	3	4	5	6	7
38. Subject co-ordinators support of teachers	1	2	3	4	5	6	7

	Situation						
	Worsened						Improved
E Objectives/Outcomes							
39. The clarity of your schools objectives in mathematics	1	2	3	4	5	6	7
40. The clarity of your school's outcomes in mathematics	1	2	3	4	5	6	7
41. The clarity of curriculum objectives of mathematics	1	2	3	4	5	6	7
42. The clarity of your curriculum outcomes in mathematics	1	2	3	4	5	6	7
43. The clarity of your objectives in teaching	1	2	3	4	5	6	7
44. The presence of objectives in all aims	1	2	3	4	5	6	7
F Curriculum Content							
45. The quantity of mathematics taught by you	1	2	3	4	5	6	7
46. The standard of mathematics throughout key stage 2	1	2	3	4	5	6	7
47. Time which is allotted to teaching mathematics	1	2	3	4	5	6	7
48. The quality of new textbooks published on mathematics	1	2	3	4	5	6	7
49. The variety of textbooks used by you in teaching of mathematics	1	2	3	4	5	6	7
50. The content of mathematics textbooks used in your classroom	1	2	3	4	5	6	7
51. The general presentation of mathematics textbooks used by you	1	2	3	4	5	6	7
G Curriculum Methodology							
52. Your use of teaching aids	1	2	3	4	5	6	7
53. Matching of the mathematics taught with children's ability level	1	2	3	4	5	6	7
54. Atmosphere in classrooms to enable learning	1	2	3	4	5	6	7
55. Appropriateness of classroom organisation	1	2	3	4	5	6	7
56. Information given to teachers about innovations	1	2	3	4	5	6	7
57. The introduction of new methods within your classroom	1	2	3	4	5	6	7
58. Teachers' attitude towards the introduction of new methods	1	2	3	4	5	6	7
59. Methodological recommendations offered in mathematical texts	1	2	3	4	5	6	7
H School - Community							
60. Relations between teachers and parents	1	2	3	4	5	6	7
61. Parents' respect for teachers	1	2	3	4	5	6	7
62. The cooperation of the community with the school	1	2	3	4	5	6	7
63. Communities respect for school	1	2	3	4	5	6	7
64. The influence of school within the community	1	2	3	4	5	6	7
I Mathematical Textbooks							
65. The quality of graphs, pictures, tables and diagrams you use	1	2	3	4	5	6	7
66. The number of tasks provided for children to solve	1	2	3	4	5	6	7
67. Are too abstract for the children's age they are produced for	1	2	3	4	5	6	7
68. Provides a content that meets the children's needs	1	2	3	4	5	6	7
69. Restricts my teaching methods	1	2	3	4	5	6	7
70. Present mathematical content accurately	1	2	3	4	5	6	7
71. Do not follow the logical sequence of the subject	1	2	3	4	5	6	7
72. Are adequate for children's self-study	1	2	3	4	5	6	7
73. Present examples, activities and exercises relevant to the children's experience	1	2	3	4	5	6	7
74. Greatly assist me in lesson preparation	1	2	3	4	5	6	7
75. Do not include material in the form of motivation or enrichment topics	1	2	3	4	5	6	7
76. Are accompanied by Teachers' Manuals I use regularly	1	2	3	4	5	6	7

	Situation Worsened						Improved
J Proportion of time/emphasis placed upon:							
77. Lecture Method	1	2	3	4	5	6	7
78. Demonstration/Illustration	1	2	3	4	5	6	7
79. Discussion	1	2	3	4	5	6	7
80. Drill and Practice	1	2	3	4	5	6	7
81. Problem Solving	1	2	3	4	5	6	7
82. Discovery Approaches	1	2	3	4	5	6	7
83. The expository style	1	2	3	4	5	6	7
84. Investigative Work	1	2	3	4	5	6	7
85. Practical Activity	1	2	3	4	5	6	7
86. Programmed learning	1	2	3	4	5	6	7
K General Question							
87. Overall, do you think the changes introduced by the National Curriculum have improved/worsened the likelihood of raising standards in primary education	1	2	3	4	5	6	7

Section B

Please circle the number that corresponds to you.

1. Sex:
1. Male
2. Female

2. Position:
1. Teacher
2. Deputy Head
3. Head-teacher

3. Qualifications:
1. Certificate in Education
2. First Degree (Bachelor's Degree)
3. Post Graduate Certificate in Education
4. Second Degree (Master's Degree)
5. Third Degree (Doctoral Degree)

4. Number of mathematics INSET courses attended during the last five years:
1. 0 Courses
2. 1 - 5 Courses
3. 6 - 10 Courses
4. 11 + Courses

5. Number of years teaching experience:
1. 0 - 3 Years
2. 3 - 7 Years
3. 8 - 12 Years
4. 12 + Years

THANK YOU for sparing some time to complete this questionnaire.

IT IS GREATLY APPRECIATED.

APPENDIX 5

LETTERS TO DIRECTORS OF EDUCATION

26 Burns Crescent,
Cefn Glas,
Bridgend CF31 4PY.
Tel: (01656) 662753

21st February 1997.

Mr. Richard Parry Jones,
Director of Education,
Isle of Anglesey County Council,
Education Department,
Parcmount,
Ffordd Glanhwfa,
Llangefni,
Anglesey LL77 7TW.

Dear Sir,
I write to enquire about the current procedures and policy concerning the use of Educational Research Questionnaires, within the primary schools in your Authority.

I am currently collating data which will be used within my Ph.D. dissertation which focuses upon 'Mathematical Attainment in Eleven-Year Olds'. This aspect of my work relates to a research instrument/questionnaire, which will illicit information relating to children's mathematical experiences within Key Stage 2, from willing participants who deliver at source, these experiences to children.

The postal questionnaire will be delivered to a sample of schools throughout Wales (proportionally distributed throughout each of the 22 Authorities), along with:

a. Letters seeking permission from Headteachers and Governing Bodies to permit the use of the questionnaire within their schools.

b. Letters inviting a selection of willing teaching staff to participate, in what I hope, is not too onerous a task in completing the questionnaire.

c. Instructions/guidance on how to complete the instrument, the test instrument itself, and a stamped addressed envelope to enable the postal return of the questionnaire.

I must stress that responses will be treated in the strictest confidence and the responses from individual staff and schools will not be featured in the Ph.D. thesis. It is my intention to analyse anonymous replies in order to produce a comprehensive report, and therefore individual staff and schools will NOT be required to give their names.

Therefore, I would be most grateful if you would outline the current procedure on the use of such a test instrument within your Authority and to receive any observations you may have on this issue. If however, there are no current restrictions on the use of such material within your Authority and I don't hear from you informing me to the contrary, I will distribute the material to selected schools after one calendar month.

Yours sincerely,

Nigel J. Coombes.

APPENDIX 6

LETTERS TO HEADTEACHERS

26 Burns Crescent
Cefn Glas
Bridgend CF31 4PY
Tel: (01656) 66 27 53
8th June 1997.

Dear Colleague,

I am writing to seek your permission to allow the use of my questionnaire within your school.

I am currently working on a part-time Ph.D. based upon 'Mathematical attainment in Eleven-Year Olds.' The enclosed questionnaire(s) relate to a large section of my work, elements of which have been derived from a previously undertaken literature review and analysis of data based upon results of mathematical attainment tests taken over a twelve year period.

If you and members of your staff would like to participate it must be stressed that all responses will be treated in the strictest confidence. In fact, no individual, no school or Education Authority will be identified.

If agreeable with you, I have enclosed four questionnaires for distribution within your school. Ideally, responses from a range of headteachers, deputy headteachers and teachers who are willing to participate, is the desired result. Once completed, the questionnaire may be returned to me using the stamped addressed envelope attached to the back of each questionnaire.

If however, you disagree with its use in your school, then I apologise for any inconvenience I may have caused and please disregard the contents of this envelope.

If you require further information on any aspect of this work please contact me at my home address (above), preferably after 6 pm.

Many thanks for your cooperation.

Yours sincerely,

Nigel J. Coombes.

APPENDIX 7

LETTER TO TEACHING STAFF

26 Burns Crescent,
Cefn Glas,
Bridgend CF31 4PY
Tel: (01656) 66 27 53
21st May 1997

Dear Colleague,

I am undertaking part-time research for a Ph.D. relating to the mathematical attainment of children in key stage 2 within schools in Wales, focussing upon 'Mathematical Attainment in Eleven-Year Olds'. Therefore it lies within the parameter of this element of the study to examine aspects of mathematics teaching and learning in primary schools.

As you are one of those involved in teaching and organising mathematics in primary schools, your opinion, suggestions and experience are of key importance within this study. I would therefore be very grateful if you would help me in my work by sparing some of your already over-stretched time by completing the attached questionnaire, which will be used for research purposes only. This postal questionnaire will be delivered to a large sample of schools throughout Wales, distributed throughout each of the 22 Authorities.

I must stress that your responses will be treated in the strictest confidence and the responses of individuals will not be featured in the Ph.D. thesis. It is my intention to analyse the replies from anonymous teachers in order to produce a comprehensive report. You are therefore NOT required to provide details of your name, school or Education Authority.

If possible, please take the time to respond, as an accurate assessment of the mathematics teaching situation in primary schools, from your viewpoint, is necessary before I am able to recommend appropriate development and improvement within this aspect of my Ph.D. thesis.

Therefore could you return the completed questionnaire in the stamped addressed envelope attached to the back of these sheets not later than **Thursday, 31st July 1997**.

Many thanks for your cooperation.

Yours sincerely,

Nigel J. Coombes.

APPENDIX 8

ALPHA COEFFICIENT OF RELIABILITY

Reliability

R E L I A B I L I T Y   A N A L Y S I S   -   S C A L E   (A L P H A)

N of Cases = 50.0

	Mean	Minimum	Maximum	Range	Max/Min	Variance
Item Means	3.2848	1.3600	4.4200	3.0600	3.2500	.4361
Item Variances	1.0077	.1371	2.4669	2.3298	17.9881	.2882

Reliability Coefficients 92 items

Alpha = .9960 Standardized item alpha = .9963

APPENDIX 9

DISTRIBUTION OF CHILDREN'S MARKS

Pupils score on test paper

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	4	1	.1	.1	.1
	6	2	.3	.3	.4
	9	2	.3	.3	.7
	11	3	.4	.4	1.0
	12	6	.8	.8	1.8
	14	12	1.6	1.6	3.4
	15	2	.3	.3	3.7
	16	10	1.3	1.3	5.0
	17	10	1.3	1.3	6.3
	18	12	1.6	1.6	7.8
	19	11	1.4	1.4	9.3
	20	12	1.6	1.6	10.8
	21	42	5.5	5.5	16.3
	22	45	5.9	5.9	22.2
	23	7	.9	.9	23.1
	24	49	6.4	6.4	29.5
	25	12	1.6	1.6	31.1
	26	60	7.8	7.8	38.9
	27	47	6.1	6.1	45.0
	28	45	5.9	5.9	50.9
	29	36	4.7	4.7	55.6
	30	19	2.5	2.5	58.1
	31	44	5.7	5.7	63.8
	32	14	1.8	1.8	65.7
	33	8	1.0	1.0	66.7
	34	48	6.3	6.3	73.0
	35	7	.9	.9	73.9
	36	36	4.7	4.7	78.6
	37	17	2.2	2.2	80.8
	38	28	3.7	3.7	84.5
	39	18	2.3	2.3	86.8
	40	17	2.2	2.2	89.0
	41	26	3.4	3.4	92.4
	42	12	1.6	1.6	94.0
	43	8	1.0	1.0	95.0
	44	13	1.7	1.7	96.7
	45	8	1.0	1.0	97.8
	46	9	1.2	1.2	99.0
	47	5	.7	.7	99.6
	48	1	.1	.1	99.7
	49	1	.1	.1	99.9
	50	1	.1	.1	100.0
	Total	766	100.0	100.0	
Total		766	100.0		

APPENDIX 10

STEM AND LEAF PLOTS FOR YEARS 1983 TO 1994

```
Pupils score on test paper Stem-and-Leaf Plot for
YEAR= 1983

 Frequency    Stem &  Leaf

     2.00        1 .  24
     3.00        1 .  678
     5.00        2 .  14444
    18.00        2 .  666667777788888899
    14.00        3 .  00111123444444
    17.00        3 .  56666677788888899
    12.00        4 .  001111122333
     1.00        4 .  5

 Stem width:        10
 Each leaf:       1 case(s)
```

```
Pupils score on test paper Stem-and-Leaf Plot for
YEAR= 1984

 Frequency    Stem &  Leaf

     1.00 Extremes     (=<6)
     2.00        1 .  14
     2.00        1 .  79
     5.00        2 .  12344
    12.00        2 .  566667778899
    15.00        3 .  000111144444444
    12.00        3 .  567788889999
     5.00        4 .  00014
     3.00        4 .  556

 Stem width:        10
 Each leaf:       1 case(s)
```

Pupils score on test paper Stem-and-Leaf Plot for
YEAR= 1985

Frequency	Stem &	Leaf
2.00	1 .	44
7.00	1 .	5677899
15.00	2 .	112222334444444
18.00	2 .	666667777777788899
13.00	3 .	1122344444444
11.00	3 .	66666678889
6.00	4 .	111112
1.00	4 .	6

Stem width: 10
Each leaf: 1 case(s)

Pupils score on test paper Stem-and-Leaf Plot for
YEAR= 1986

Frequency	Stem &	Leaf
3.00	1 .	124
5.00	1 .	67799
13.00	2 .	0011112222244
18.00	2 .	666666677788899999
13.00	3 .	0001111124444
9.00	3 .	566778889
3.00	4 .	124

Stem width: 10
Each leaf: 1 case(s)

Pupils score on test paper Stem-and-Leaf Plot for
YEAR= 1987

```
 Frequency     Stem &  Leaf

     1.00 Extremes     (=<4)
     1.00        0 .  6
     1.00        1 .  4
     5.00        1 .  56678
    14.00        2 .  01122222444444
    16.00        2 .  5566666778899999
     8.00        3 .  01112344
    11.00        3 .  66667888889
     4.00        4 .  0011

 Stem width:        10
 Each leaf:       1 case(s)
```

Pupils score on test paper Stem-and-Leaf Plot for
YEAR= 1988

```
 Frequency     Stem &  Leaf

     4.00        1 .  1244
     2.00        1 .  89
    21.00        2 .  000111112222233344444
    21.00        2 .  566666777778888888999
    21.00        3 .  000011111122334444444
     5.00        3 .  66799
     7.00        4 .  0011234

 Stem width:        10
 Each leaf:       1 case(s)
```

ب

Pupils score on test paper Stem-and-Leaf Plot for
YEAR= 1989

Frequency	Stem &	Leaf
2.00	1 .	22
7.00	1 .	6788999
29.00	2 .	00111111111122222222444444444
33.00	2 .	556666666667777777888888899999999
16.00	3 .	0011111112224444
6.00	3 .	566667
5.00	4 .	01244

Stem width: 10
Each leaf: 1 case(s)

Pupils score on test paper Stem-and-Leaf Plot for
YEAR= 1990

Frequency	Stem &	Leaf
.00	1 .	
1.00	1 .	2
3.00	1 .	444
5.00	1 .	66667
5.00	1 .	88899
13.00	2 .	0001111111111
14.00	2 .	22222222222223
11.00	2 .	44444444555
18.00	2 .	666666666677777777
11.00	2 .	88888888999
10.00	3 .	0011111111
3.00	3 .	223
5.00	3 .	44444
2.00	3 .	66
1.00	3 .	9
5.00	Extremes	(>=41)

Stem width: 10
Each leaf: 1 case(s)

```
Pupils score on test paper Stem-and-Leaf Plot for
YEAR= 1991

 Frequency    Stem &  Leaf

     1.00        1 .  4
     2.00        1 .  78
    14.00        2 .  01111111224444
    24.00        2 .  566666666677778888889999
     7.00        3 .  1111344
     8.00        3 .  66667789
     4.00        4 .  1123

 Stem width:         10
 Each leaf:        1 case(s)
```

```
Pupils score on test paper Stem-and-Leaf Plot for
YEAR= 1992

 Frequency    Stem &  Leaf

     1.00        1 .  8
     3.00        2 .  244
     4.00        2 .  5569
     3.00        3 .  044
     8.00        3 .  56668999
     7.00        4 .  0012234
     3.00        4 .  568

 Stem width:         10
 Each leaf:        1 case(s)
```

```
Pupils score on test paper Stem-and-Leaf Plot for
YEAR= 1993

 Frequency    Stem &  Leaf

     1.00        2 .  8
     3.00        3 .  022
     6.00        3 .  667889
     8.00        4 .  00012234
     9.00        4 .  556666779

 Stem width:        10
 Each leaf:       1 case(s)
```

```
Pupils score on test paper Stem-and-Leaf Plot for
YEAR= 1994

 Frequency    Stem &  Leaf

     3.00 Extremes     (=<18)
     1.00        2 .  2
     3.00        2 .  789
     2.00        3 .  13
    10.00        3 .  5567778889
    11.00        4 .  00111234444
     6.00        4 .  556677
     1.00        5 .  0

 Stem width:        10
 Each leaf:       1 case(s)
```

APPENDIX 11

COMPUTATIONAL SKILLS SCORES 1992-1994

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Year test taken * Question 1 Crosstabulation

Count

		Question 1		
		Incorrect answer	Correct answer	Total
Year test taken	1992	5	24	29
	1993	6	21	27
	1994	5	32	37
Total		16	77	93

Year test taken * Question 8 Crosstabulation

Count

		Question 8		
		Incorrect answer	Correct answer	Total
Year test taken	1992	4	25	29
	1993	4	23	27
	1994	5	32	37
Total		13	80	93

Year test taken * Question 14 Crosstabulation

Count

		Question 14		
		Incorrect answer	Correct answer	Total
Year test taken	1992	3	26	29
	1993	2	25	27
	1994	3	34	37
Total		8	85	93

Year test taken * Question 18 Crosstabulation

Count

		Question 18		
		Incorrect answer	Correct answer	Total
Year test taken	1992	6	23	29
	1993	2	25	27
	1994	3	34	37
Total		11	82	93

Year test taken * Question 27 Crosstabulation

Count

		Question 27		
		Incorrect answer	Correct answer	Total
Year test taken	1992	5	24	29
	1993	4	23	27
	1994	4	33	37
Total		13	80	93

Year test taken * Question 29 Crosstabulation

Count

		Question 29		
		Incorrect answer	Correct answer	Total
Year test taken	1992	9	20	29
	1993	4	23	27
	1994	3	34	37
Total		16	77	93

Year test taken * Question 31 Crosstabulation

Count

		Question 31		
		Incorrect answer	Correct answer	Total
Year test taken	1992	4	25	29
	1993	4	23	27
	1994	3	34	37
Total		11	82	93

Year test taken * Question 35 Crosstabulation

Count

		Question 35		
		Incorrect answer	Correct answer	Total
Year test taken	1992	9	20	29
	1993	3	24	27
	1994	4	33	37
Total		16	77	93

Year test taken * Question 36 Crosstabulation

Count

		Question 36		
		Incorrect answer	Correct answer	Total
Year test taken	1992	8	21	29
	1993	4	23	27
	1994	8	29	37
Total		20	73	93

Year test taken * Question 38 Crosstabulation

Count

		Question 38		
		Incorrect answer	Correct answer	Total
Year test taken	1992	9	20	29
	1993	4	23	27
	1994	9	28	37
Total		22	71	93

Year test taken * Question 41 Crosstabulation

Count

		Question 41		
		Incorrect answer	Correct answer	Total
Year test taken	1992	12	17	29
	1993	5	22	27
	1994	15	22	37
Total		32	61	93

APPENDIX 12

RECALL OF BASIC FACTS SCORES 1992-1994

Year test taken * Question 10 Crosstabulation

Count

		Question 10 Incorrect answer	Question 10 Correct answer	Total
Year test taken	1992	8	21	29
	1993	3	24	27
	1994	6	31	37
Total		17	76	93

Year test taken * Question 12 Crosstabulation

Count

		Question 12 Incorrect answer	Question 12 Correct answer	Total
Year test taken	1992	7	22	29
	1993	4	23	27
	1994	6	31	37
Total		17	76	93

Year test taken * Question 15 Crosstabulation

Count

		Question 15 Incorrect answer	Question 15 Correct answer	Total
Year test taken	1992	10	19	29
	1993	2	25	27
	1994	5	32	37
Total		17	76	93

Year test taken * Question 21 Crosstabulation

Count

		Question 21 Incorrect answer	Question 21 Correct answer	Total
Year test taken	1992	7	22	29
	1993	3	24	27
	1994	6	31	37
Total		16	77	93

Year test taken * Question 25 Crosstabulation

Count

		Question 25 Incorrect answer	Question 25 Correct answer	Total
Year test taken	1992	7	22	29
	1993	3	24	27
	1994	8	29	37
Total		18	75	93

Year test taken * Question 26 Crosstabulation

Count

		Question 26 Incorrect answer	Question 26 Correct answer	Total
Year test taken	1992	10	19	29
	1993	2	25	27
	1994	7	30	37
Total		19	74	93

Year test taken * Question 37 Crosstabulation

Count

		Question 37 Incorrect answer	Question 37 Correct answer	Total
Year test taken	1992	6	23	29
	1993	5	22	27
	1994	13	24	37
Total		24	69	93

Year test taken * Question 42 Crosstabulation

Count

		Question 42 Incorrect answer	Question 42 Correct answer	Total
Year test taken	1992	6	23	29
	1993	2	25	27
	1994	6	31	37
Total		14	79	93

APPENDIX 13

APPLICATION OF CONCEPTS AND SKILLS SCORES 1992-1994

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Year test taken * Question 5 Crosstabulation

Count

		Question 5 Incorrect answer	Question 5 Correct answer	Total
Year test taken	1992	13	16	29
	1993	9	18	27
	1994	12	25	37
Total		34	59	93

Year test taken * Question 7 Crosstabulation

Count

		Question 7 Incorrect answer	Question 7 Correct answer	Total
Year test taken	1992	12	17	29
	1993	10	17	27
	1994	11	26	37
Total		33	60	93

Year test taken * Question 11 Crosstabulation

Count

		Question 11 Incorrect answer	Question 11 Correct answer	Total
Year test taken	1992	13	16	29
	1993	9	18	27
	1994	12	25	37
Total		34	59	93

Year test taken * Question 13 Crosstabulation

Count

		Question 13 Incorrect answer	Question 13 Correct answer	Total
Year test taken	1992	11	18	29
	1993	5	22	27
	1994	11	26	37
Total		27	66	93

Year test taken * Question 17 Crosstabulation

Count

		Question 17 Incorrect answer	Question 17 Correct answer	Total
Year test taken	1992	7	22	29
	1993	5	22	27
	1994	12	25	37
Total		30	63	93

Year test taken * Question 19 Crosstabulation

Count

		Question 19 Incorrect answer	Question 19 Correct answer	Total
Year test taken	1992	12	17	29
	1993	5	22	27
	1994	9	28	37
Total		26	67	93

Year test taken * Question 20 Crosstabulation

Count

		Question 20 Incorrect answer	Question 20 Correct answer	Total
Year test taken	1992	11	18	29
	1993	3	24	27
	1994	10	27	37
Total		24	69	93

Year test taken * Question 24 Crosstabulation

Count

		Question 24 Incorrect answer	Question 24 Correct answer	Total
Year test taken	1992	10	19	29
	1993	5	22	27
	1994	12	25	37
Total		27	66	93

Year test taken * Question 30 Crosstabulation

Count

		Question 30		
		Incorrect answer	Correct answer	Total
Year test taken	1992	11	18	29
	1993	7	20	27
	1994	12	25	37
Total		30	63	93

Year test taken * Question 32 Crosstabulation

Count

		Question 32		
		Incorrect answer	Correct answer	Total
Year test taken	1992	10	19	29
	1993	6	21	27
	1994	15	22	37
Total		31	62	93

Year test taken * Question 33 Crosstabulation

Count

		Question 33		
		Incorrect answer	Correct answer	Total
Year test taken	1992	10	19	29
	1993	9	18	27
	1994	19	18	37
Total		38	55	93

Year test taken * Question 34 Crosstabulation

Count

		Question 34		
		Incorrect answer	Correct answer	Total
Year test taken	1992	12	17	29
	1993	14	13	27
	1994	22	15	37
Total		48	45	93

Year test taken * Question 45 Crosstabulation

Count

		Question 45		
		Incorrect answer	Correct answer	Total
Year test taken	1992	11	18	29
	1993	16	11	27
	1994	26	11	37
Total		53	40	93

APPENDIX 14

UNDERSTANDING OF BASIC CONCEPTS SCORES 1992-1994

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Year test taken * Question 2 Crosstabulation

Count

		Question 2 Incorrect answer	Question 2 Correct answer	Total
Year test taken	1992	11	18	29
	1993	8	19	27
	1994	11	26	37
Total		30	63	93

Year test taken * Question 3 Crosstabulation

Count

		Question 3 Incorrect answer	Question 3 Correct answer	Total
Year test taken	1992	11	18	29
	1993	7	20	27
	1994	12	25	37
Total		30	63	93

Year test taken * Question 4 Crosstabulation

Count

		Question 4 Incorrect answer	Question 4 Correct answer	Total
Year test taken	1992	9	20	29
	1993	3	24	27
	1994	9	28	37
Total		21	72	93

Year test taken * Question 6 Crosstabulation

Count

		Question 6 Incorrect answer	Question 6 Correct answer	Total
Year test taken	1992	9	20	29
	1993	2	25	27
	1994	8	29	37
Total		19	74	93

Year test taken * Question 9 Crosstabulation

Count

		Question 9 Incorrect answer	Question 9 Correct answer	Total
Year test taken	1992	10	19	29
	1993	3	24	27
	1994	8	29	37
Total		21	72	93

Year test taken * Question 16 Crosstabulation

Count

		Question 16 Incorrect answer	Question 16 Correct answer	Total
Year test taken	1992	7	22	29
	1993	3	24	27
	1994	8	29	37
Total		18	75	93

Year test taken * Question 22 Crosstabulation

Count

		Question 22 Incorrect answer	Question 22 Correct answer	Total
Year test taken	1992	10	19	29
	1993	1	26	27
	1994	8	29	37
Total		19	74	93

Year test taken * Question 23 Crosstabulation

Count

		Question 23 Incorrect answer	Question 23 Correct answer	Total
Year test taken	1992	8	21	29
	1993	1	26	27
	1994	3	34	37
Total		12	81	93

Year test taken * Question 28 Crosstabulation

Count

		Question 28 Incorrect answer	Question 28 Correct answer	Total
Year test taken	1992	11	18	29
	1993		27	27
	1994	6	31	37
Total		12	81	93

Year test taken * Question 39 Crosstabulation

Count

		Question 39 Incorrect answer	Question 39 Correct answer	Total
Year test taken	1992	3	26	29
	1993	2	25	27
	1994	4	33	37
Total		9	84	93

Year test taken * Question 40 Crosstabulation

Count

		Question 40 Incorrect answer	Question 40 Correct answer	Total
Year test taken	1992	8	21	29
	1993		27	27
	1994	5	32	37
Total		13	80	93

Year test taken * Question 42 Crosstabulation

Count

		Question 42 Incorrect answer	Question 42 Correct answer	Total
Year test taken	1992	6	23	29
	1993	2	25	27
	1994	6	31	37
Total		14	79	93

Year test taken * Question 44 Crosstabulation

Count

		Question 44		
		Incorrect answer	Correct answer	Total
Year test taken	1992	7	22	29
	1993	3	24	27
	1994	9	28	37
Total		19	74	93

Year test taken * Question 46 Crosstabulation

Count

		Question 46		
		Incorrect answer	Correct answer	Total
Year test taken	1992	5	24	29
	1993	5	22	27
	1994	10	27	37
Total		20	73	93

Year test taken * Question 47 Crosstabulation

Count

		Question 47		
		Incorrect answer	Correct answer	Total
Year test taken	1992	6	23	29
	1993	7	20	27
	1994	12	25	37
Total		25	68	93

Year test taken * Question 48 Crosstabulation

Count

		Question 48		
		Incorrect answer	Correct answer	Total
Year test taken	1992	7	22	29
	1993	9	18	27
	1994	14	23	37
Total		30	63	93

Year test taken * Question 49 Crosstabulation

Count

		Question 49		
		Incorrect answer	Correct answer	Total
Year test taken	1992	9	20	29
	1993	10	17	27
	1994	15	22	37
Total		34	59	93

Year test taken * Question 50 Crosstabulation

Count

		Question 50		
		Incorrect answer	Correct answer	Total
Year test taken	1992	9	20	29
	1993	12	15	27
	1994	17	20	37
Total		38	55	93

APPENDIX 15

MALE/FEMALE COMPUTATIONAL SKILLS SCORES

Gender * Question 1 Crosstabulation

Count

		Question 1		
		Incorrect answer	Correct answer	Total
Gender	Male	6	39	45
	Female	10	38	48
Total		16	77	93

Gender * Question 8 Crosstabulation

Count

		Question 8		
		Incorrect answer	Correct answer	Total
Gender	Male	5	40	45
	Female	8	40	48
Total		13	80	93

Gender * Question 14 Crosstabulation

Count

		Question 14		
		Incorrect answer	Correct answer	Total
Gender	Male	3	42	45
	Female	5	43	48
Total		8	85	93

Gender * Question 18 Crosstabulation

Count

		Question 18		
		Incorrect answer	Correct answer	Total
Gender	Male	4	41	45
	Female	7	41	48
Total		11	82	93

Gender * Question 27 Crosstabulation

Count

		Question 27		
		Incorrect answer	Correct answer	Total
Gender	Male	2	43	45
	Female	11	37	48
Total		13	80	93

Gender * Question 29 Crosstabulation

Count

		Question 29		
		Incorrect answer	Correct answer	Total
Gender	Male	8	37	45
	Female	8	40	48
Total		16	77	93

Gender * Question 31 Crosstabulation

Count

		Question 31		
		Incorrect answer	Correct answer	Total
Gender	Male	4	41	45
	Female	7	41	48
Total		11	82	93

Gender * Question 35 Crosstabulation

Count

		Question 35		
		Incorrect answer	Correct answer	Total
Gender	Male	7	38	45
	Female	9	39	48
Total		16	77	93

Gender * Question 36 Crosstabulation

Count

		Question 36		
		Incorrect answer	Correct answer	Total
Gender	Male	8	37	45
	Female	12	36	48
Total		20	73	93

Gender * Question 38 Crosstabulation

Count

		Question 38		
		Incorrect answer	Correct answer	Total
Gender	Male	10	35	45
	Female	12	36	48
Total		22	71	93

Gender * Question 41 Crosstabulation

Count

		Question 41		Total
		Incorrect answer	Correct answer	
Gender	Male	17	28	45
	Female	15	33	48
Total		32	61	93

APPENDIX 16

MALE/FEMALE RECALL OF BASIC FACTS SCORES

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Gender * Question 10 Crosstabulation

Count

		Question 10		
		Incorrect answer	Correct answer	Total
Gender	Male	2	43	45
	Female	15	33	48
Total		17	76	93

Gender * Question 12 Crosstabulation

Count

		Question 12		
		Incorrect answer	Correct answer	Total
Gender	Male	3	42	45
	Female	14	34	48
Total		17	76	93

Gender * Question 15 Crosstabulation

Count

		Question 15		
		Incorrect answer	Correct answer	Total
Gender	Male	6	39	45
	Female	11	37	48
Total		17	76	93

Gender * Question 21 Crosstabulation

Count

		Question 21		
		Incorrect answer	Correct answer	Total
Gender	Male	4	41	45
	Female	12	36	48
Total		16	77	93

Gender * Question 25 Crosstabulation

Count

		Question 25		
		Incorrect answer	Correct answer	Total
Gender	Male	6	39	45
	Female	12	36	48
Total		18	75	93

Gender * Question 26 Crosstabulation

Count

		Question 26 Incorrect answer	Question 26 Correct answer	Total
Gender	Male	9	36	45
	Female	10	38	48
Total		19	74	93

Gender * Question 37 Crosstabulation

Count

		Question 37 Incorrect answer	Question 37 Correct answer	Total
Gender	Male	10	35	45
	Female	14	34	48
Total		24	69	93

Gender * Question 42 Crosstabulation

Count

		Question 42 Incorrect answer	Question 42 Correct answer	Total
Gender	Male	7	38	45
	Female	7	41	48
Total		14	79	93

APPENDIX 17

MALE/FEMALE APPLICATION OF CONCEPTS AND SKILLS SCORES

Gender * Question 5 Crosstabulation

Count

		Question 5		
		Incorrect answer	Correct answer	Total
Gender	Male	15	30	45
	Female	19	29	48
Total		34	59	93

Gender * Question 7 Crosstabulation

Count

		Question 7		
		Incorrect answer	Correct answer	Total
Gender	Male	14	31	45
	Female	19	29	48
Total		33	60	93

Gender * Question 11 Crosstabulation

Count

		Question 11		
		Incorrect answer	Correct answer	Total
Gender	Male	14	31	45
	Female	20	28	48
Total		34	59	93

Gender * Question 13 Crosstabulation

Count

		Question 13		
		Incorrect answer	Correct answer	Total
Gender	Male	8	37	45
	Female	19	29	48
Total		27	66	93

Gender * Question 17 Crosstabulation

Count

		Question 17		
		Incorrect answer	Correct answer	Total
Gender	Male	12	33	45
	Female	18	30	48
Total		30	63	93

Gender * Question 19 Crosstabulation

Count

		Question 19 Incorrect answer	Question 19 Correct answer	Total
Gender	Male	12	33	45
	Female	14	34	48
Total		26	67	93

Gender * Question 20 Crosstabulation

Count

		Question 20 Incorrect answer	Question 20 Correct answer	Total
Gender	Male	10	35	45
	Female	14	34	48
Total		24	69	93

Gender * Question 24 Crosstabulation

Count

		Question 24 Incorrect answer	Question 24 Correct answer	Total
Gender	Male	10	35	45
	Female	17	31	48
Total		27	66	93

Gender * Question 30 Crosstabulation

Count

		Question 30 Incorrect answer	Question 30 Correct answer	Total
Gender	Male	13	32	45
	Female	17	31	48
Total		30	63	93

Gender * Question 32 Crosstabulation

Count

		Question 32 Incorrect answer	Question 32 Correct answer	Total
Gender	Male	13	32	45
	Female	18	30	48
Total		31	62	93

Gender * Question 33 Crosstabulation

Count

		Question 33		
		Incorrect answer	Correct answer	Total
Gender	Male	14	31	45
	Female	24	24	48
Total		38	55	93

Gender * Question 34 Crosstabulation

Count

		Question 34		
		Incorrect answer	Correct answer	Total
Gender	Male	20	25	45
	Female	28	20	48
Total		48	45	93

Gender * Question 45 Crosstabulation

Count

		Question 45		
		Incorrect answer	Correct answer	Total
Gender	Male	24	21	45
	Female	29	19	48
Total		53	40	93

APPENDIX 18

MALE/FEMALE UNDERSTANDING OF BASIC CONCEPTS SCORES

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Gender * Question 2 Crosstabulation

Count

		Question 2		
		Incorrect answer	Correct answer	Total
Gender	Male	8	37	45
	Female	22	26	48
Total		30	63	93

Gender * Question 3 Crosstabulation

Count

		Question 3		
		Incorrect answer	Correct answer	Total
Gender	Male	8	37	45
	Female	22	26	48
Total		30	63	93

Gender * Question 4 Crosstabulation

Count

		Question 4		
		Incorrect answer	Correct answer	Total
Gender	Male	5	40	45
	Female	16	32	48
Total		21	72	93

Gender * Question 6 Crosstabulation

Count

		Question 6		
		Incorrect answer	Correct answer	Total
Gender	Male	5	40	45
	Female	14	34	48
Total		19	74	93

Gender * Question 9 Crosstabulation

Count

		Question 9		
		Incorrect answer	Correct answer	Total
Gender	Male	9	36	45
	Female	12	36	48
Total		21	72	93

Gender * Question 16 Crosstabulation

Count

		Question 16		
		Incorrect answer	Correct answer	Total
Gender	Male	9	36	45
	Female	9	39	48
Total		18	75	93

Gender * Question 22 Crosstabulation

Count

		Question 22		
		Incorrect answer	Correct answer	Total
Gender	Male	11	34	45
	Female	8	40	48
Total		19	74	93

Gender * Question 23 Crosstabulation

Count

		Question 23		
		Incorrect answer	Correct answer	Total
Gender	Male	6	39	45
	Female	6	42	48
Total		12	81	93

Gender * Question 28 Crosstabulation

Count

		Question 28		
		Incorrect answer	Correct answer	Total
Gender	Male	7	38	45
	Female	5	43	48
Total		12	81	93

Gender * Question 39 Crosstabulation

Count

		Question 39		
		Incorrect answer	Correct answer	Total
Gender	Male	5	40	45
	Female	4	44	48
Total		9	84	93

Gender * Question 40 Crosstabulation

Count

		Question 40		
		Incorrect answer	Correct answer	Total
Gender	Male	7	38	45
	Female	6	42	48
Total		13	80	93

Gender * Question 42 Crosstabulation

Count

		Question 42		
		Incorrect answer	Correct answer	Total
Gender	Male	7	38	45
	Female	7	41	48
Total		14	79	93

Gender * Question 44 Crosstabulation

Count

		Question 44		
		Incorrect answer	Correct answer	Total
Gender	Male	10	35	45
	Female	9	39	48
Total		19	74	93

Gender * Question 46 Crosstabulation

Count

		Question 46		
		Incorrect answer	Correct answer	Total
Gender	Male	9	36	45
	Female	11	37	48
Total		20	73	93

Gender * Question 47 Crosstabulation

Count

		Question 47		
		Incorrect answer	Correct answer	Total
Gender	Male	11	34	45
	Female	14	34	48
Total		25	68	93

Gender * Question 48 Crosstabulation

Count

		Question 48		Total
		Incorrect answer	Correct answer	
Gender	Male	12	33	45
	Female	18	30	48
Total		30	63	93

Gender * Question 49 Crosstabulation

Count

		Question 49		Total
		Incorrect answer	Correct answer	
Gender	Male	11	34	45
	Female	23	25	48
Total		34	59	93

Gender * Question 50 Crosstabulation

Count

		Question 50		Total
		Incorrect answer	Correct answer	
Gender	Male	13	32	45
	Female	25	23	48
Total		38	55	93

APPENDIX 19

MATRIX OF RESPONSE SCORES FROM NATIONAL QUESTIONNAIRE

	Raw Scores Recorded									
	1	2	3	4	5	6	7	mean	med	mode
A Children's Knowledge										
01. Children's reading skills	4	34	56	100	62	18	0	3.86	4	4
02. Children's ability to comprehend written passages	4	48	44	74	82	22	0	3.91	4	5
03. Children's oral skills	**0**	**16**	**34**	**120**	**78**	**26**	**0**	**4.23**	**4**	**4**
04. Children's ability to comprehend oral speech	**0**	**4**	**46**	**136**	**68**	**20**	**0**	**4.20**	**4**	**4**
05. Children's listening skills	20	42	50	102	48	12	0	3.55	4	4
06. Children's writing	8	54	38	86	68	20	0	3.77	4	4
07. Children's ability to perform written commands	8	36	40	124	56	10	0	3.78	4	4
08. Children's ability in computation	4	24	64	90	72	20	0	3.96	4	4
09. The ability to problem solve in mathematics	**16**	**14**	**32**	**70**	**108**	**26**	**8**	**4.28**	**5**	**5**
10. The quality of knowledge that is acquired by children	**8**	**24**	**60**	**70**	**70**	**30**	**12**	**4.12**	**4**	**4**
11. The quantity of knowledge that is acquired by children	**4**	**16**	**49**	**71**	**102**	**24**	**8**	**4.30**	**4**	**5**
12. The ability to complete investigative tasks	**4**	**18**	**36**	**58**	**100**	**50**	**8**	**4.51**	**5**	**5**
B. Children's Affective Domain										
13. Children's regular attendance	**0**	**0**	**8**	**222**	**40**	**4**	**0**	**4.14**	**4**	**4**
14. Children's conduct in school	16	32	66	134	22	4	0	3.46	4	4
15. Children's respect towards teachers	24	38	58	128	26	0	0	3.34	4	4
16. Cooperation among children	16	12	50	138	54	4	0	3.78	4	4
17. Willingness to co-operate with teacher	8	0	72	142	44	8	0	3.87	4	4
18. Children's sense of responsibility	4	28	62	112	66	2	0	3.78	4	4
19. Children's interest for learning	0	20	64	110	76	4	0	3.93	4	4
20. Children's level of commitment	0	42	42	120	70	0	0	3.80	4	4
21. Children's willingness to volunteer ideas	**4**	**10**	**28**	**120**	**92**	**20**	**0**	**4.26**	**4**	**4**

	Raw Scores Recorded									
	1	2	3	4	5	6	7	mean	med	mode
E Objectives/Outcomes										
39. The clarity of your schools objectives in mathematics	0	0	2	56	120	70	26	5.23	5	5
40. The clarity of your school's outcomes in mathematics	0	0	14	62	124	56	18	5.01	5	5
41. The clarity of curriculum objectives of mathematics	0	4	2	52	122	82	12	5.14	5	5
42. The clarity of your curriculum outcomes in mathematics	0	4	6	54	134	60	16	5.05	5	5
43. The clarity of your objectives in teaching	0	0	10	54	138	62	10	5.03	5	5
44. The presence of objectives in all aims	0	0	6	48	140	72	8	5.10	5	5
F Curriculum Content										
45. The quantity of mathematics taught by you	0	8	26	92	86	42	20	4.69	5	4
46. The standard of mathematics throughout key stage 2	0	10	52	96	60	44	12	4.41	4	4
47. Time which is allotted to teaching mathematics	4	20	46	94	60	42	8	4.26	4	4
48. The quality of new textbooks published on mathematics	0	4	10	58	140	54	8	4.93	5	5
49. The variety of textbooks used in teaching of mathematics	0	0	12	90	126	32	14	4.80	5	5
50. The content of mathematics textbooks used in classroom	0	0	18	62	140	48	6	4.86	5	5
51. The general presentation of mathematics textbooks used	0	0	12	46	142	58	16	5.07	5	5

2

	Raw Scores Recorded 1	2	3	4	5	6	7	mean	med	mode
G Curriculum Methodology										
52. Your use of teaching aids	**0**	**4**	**2**	**126**	**106**	**32**	**4**	**4.63**	**5**	**4**
53. Matching of the mathematics taught with children's ability	**0**	**0**	**16**	**106**	**106**	**36**	**10**	**4.70**	**5**	**4**
54. Atmosphere in classrooms to enable learning	**0**	**8**	**38**	**128**	**78**	**20**	**2**	**4.26**	**4**	**4**
55. Appropriateness of classroom organisation	**0**	**0**	**16**	**136**	**78**	**42**	**2**	**4.55**	**4**	**4**
56. Information given to teachers about innovations	**0**	**24**	**8**	**104**	**112**	**20**	**6**	**4.42**	**5**	**5**
57. The introduction of new methods within your classroom	**0**	**12**	**16**	**114**	**96**	**28**	**8**	**4.50**	**4**	**4**
58. Teachers' attitude towards the introduction of new methods	**6**	**12**	**24**	**98**	**86**	**38**	**10**	**4.46**	**4**	**4**
59. Methodological recommendations offered in mathematical texts	0	12	20	114	94	26	8	4.46	4	4
H School - Community										
60. Relations between teachers and parents	**4**	**8**	**10**	**150**	**56**	**36**	**10**	**4.44**	**4**	**4**
61. Parents' respect for teachers	44	16	98	76	30	4	6	3.25	3	3
62. The cooperation of the community with the school	**8**	**0**	**44**	**136**	**50**	**32**	**4**	**4.21**	**4**	**4**
63. Communities respect for school	20	20	54	124	28	28	0	3.74	4	4
64. The influence of school within the community	4	14	50	148	36	18	4	3.98	4	4

Raw Scores Recorded

I Mathematical Textbooks

	1	2	3	4	5	6	7	mean	med	mode
65. The quality of graphs, pictures, tables and diagrams used	0	0	4	94	124	44	8	4.85	5	5
66. The number of tasks provided for children to solve	0	4	18	94	104	50	4	4.69	5	5
67. Are too abstract for the children's age they are produced for	0	18	36	162	54	4	0	3.96	4	4
68. Provides a content that meets the children's needs	0	0	48	138	62	22	4	4.26	4	4
69. Restricts my teaching methods	0	6	38	178	34	14	4	4.09	4	4
70. Present mathematical content accurately	0	0	28	168	60	14	4	4.26	4	4
71. Do not follow the logical sequence of the subject	0	12	66	120	68	4	4	3.99	4	4
72. Are adequate for children's self-study	0	14	56	138	46	15	5	4.03	4	4
73. Present examples, activities and exercises relevant to the children's experience	6	8	48	122	66	16	8	4.15	4	4
74. Greatly assist me in lesson preparation	2	12	40	92	100	24	4	4.33	4	5
75. Do not include material in the form of motivation or enrichment topics	8	2	44	132	74	14	0	4.11	4	4
76. Are accompanied by Teachers' Manuals I use regularly	0	0	16	120	92	38	8	4.64	5	4

	Raw Scores Recorded									
	1	2	3	4	5	6	7	mean	med	mode
J Proportion of time/emphasis placed upon:										
77. Lecture Method	**0**	**10**	**20**	**154**	**70**	**12**	**8**	**4.28**	**4**	**4**
78. Demonstration/Illustration	**0**	**0**	**18**	**126**	**106**	**20**	**4**	**4.51**	**4**	**4**
79. Discussion	**0**	**4**	**16**	**108**	**98**	**44**	**4**	**4.64**	**5**	**4**
80. Drill and Practice	**0**	**10**	**40**	**116**	**72**	**28**	**8**	**4.34**	**4**	**4**
81. Problem Solving	**0**	**14**	**26**	**72**	**114**	**40**	**8**	**4.60**	**5**	**5**
82. Discovery Approaches	**2**	**4**	**78**	**64**	**74**	**48**	**4**	**4.33**	**4**	**3**
83. The expository style	**0**	**4**	**16**	**132**	**90**	**28**	**4**	**4.49**	**4**	**4**
84. Investigative Work	**0**	**0**	**26**	**50**	**130**	**58**	**10**	**4.91**	**5**	**5**
85. Practical Activity	**0**	**8**	**20**	**72**	**114**	**52**	**8**	**4.75**	**5**	**5**
86. Programmed learning	**8**	**12**	**22**	**136**	**64**	**28**	**4**	**4.23**	**4**	**4**
K General Question										
87. Overall, do you think the changes introduced by the National Curriculum have improved/worsened the likelihood of raising standards in primary education	24	34	48	36	100	22	10	3.95	4	5